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FALL RIVER HARBOR
MASSACHUSETTS RHODE ISLAND

SURVEY
(REVIEW OF REPORTS)

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JANUARY 1967

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SYLLABUS

The Division Engineer finds that the existing channels in Fall River Harbor, Massachusetts and Rhode Island are inadequate for vessels presently using the waterway. He further finds that the inadequacy would preclude navigation by the larger vessels that will be engaged in future commerce in petroleum products and bituminous coal. The prospective commerce will be destined to two conventional power plants and six oil terminals. He finds that one bridge across the Taunton River will require alteration to provide for a wider drawspan, and that a second bridge will need to be removed. Sufficient general benefits will result to warrant Federal participation in the harbor improvement.

The Division Engineer therefore recommends that the existing project in Fall River Harbor be modified to provide for:

a. Deepening the existing 400-foot wide by 35-foot deep Mt. Hope Bay Channel to 40 feet within existing channel limits from deep water in Mt. Hope Bay to and including the existing turning basin, upriver of the bridges.

b. Deepening the existing 400-foot wide by 35-foot deep Tiverton channel to a depth of 40 feet to the vicinity of the Tiverton shore, thence upstream to the vicinity of the Gulf Oil Terminal and widening the bend leading into this channel to 600 feet.

c. A channel 400 feet wide and 40 feet deep in Tiverton Lower Pool along the Tiverton waterfront to the vicinity of the Rhode Island Refining Corporation; and

d. Altering the Brightman Street Bridge to provide for a clear channel width of 300 feet through the drawspan.

The project recommendation is shown on the map accompanying this report. The estimated Federal costs for new work would be $8, 762, 000 plus local costs of $497,000 for altering the Brightman Street Bridge in accordance with provisions of the Truman-Hobbs Act. The project recommendation is contingent upon certain requirements of local cooperation, including the removal of the Slades Ferry Bridge. The benefit-cost ratio is 3. 9.

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Attachment Information Required by Senate Resolution 148

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO
NEDED-R

4 January 1967

SUBJECT: Survey (Review of Reports) of Fall River Harbor, Massachusetts

TO: Chief of Engineers
ATTN: ENGCW-P

AUTHORITY

1. This report is submitted in compliance with a resolution adopted 31 July 1957 by the Committee on Public Works of the House of Representatives, United States. The resolution reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Fall River Harbor, Massachusetts, published in House Document No. 405, 83d Congress, 2d Session, and previous reports, with a view to determining if it is advisable to modify the existing project in Rhode Island and Massachusetts in any way at this time, particularly with respect to provision of a 45-foot depth."

2. The Chief of Engineers assigned the review of reports to the New England Division.

PURPOSE AND EXTENT OF STUDY

3. The study was made to determine the economic justification of modifying the existing Federal navigation project in accordance with the needs and desires of local interests. For purposes of the study, and preparation of its attendant report, detailed field investigations were necessary. These investigations included hydrographic

surveys and probings to determine the amount and character of materials to be handled in all considered plans of improvement. To supplement this information, all available maps, charts, aerial photographs, commercial statistics, previous field data, and other matter pertaining to the locality were studied. All of the foregoing data were supplemented by information obtained from a public hearing, held in Fall River City Hall on 22 June 1961. From this hearing, the specific details of all improvements desired by local interests were determined. The details are described later in this report in the section titled, Improvements Desired. In addition, subsequent contacts were made with local interests in order that all aspects of the desired improvement could be considered and reaffirmed.

DESCRIPTION OF NAVIGATION CONDITIONS

4. The major area of Fall River Harbor lies in southeastern Massachusetts in the municipalities of Fall River and Somerset. The remainder abuts the shore of Tiverton, Rhode Island. The harbor itself is about 50 miles from Boston, Massachusetts and 22 miles from the entrance to Narragansett Bay. Navigation from the Atlantic Ocean is obtained through the well sheltered and relatively deep waters of Narragansett and Mt. Hope Bays. The head of Mt. Hope Bay and the lower portion of the Taunton River, which flows into this bay, comprise the commercially developed section of the harbor in Massachusetts. The Tiverton shore area contains the commercially developed portion lying in Rhode Island. The harbor is about 7 miles long and has widths varying from 2.5 miles at its lower extremity to about 1000 feet at its upper end.

5. Navigational improvements have been accomplished by the Federal Government in various construction works, the first of which was authorized in 1874. Channels 35 feet deep have been provided along the Tiverton waterfront and in the bay to the head of the harbor. Beyond this latter point, small craft navigation is possible in the Taunton River for a distance of about 11 miles. The head of navigation is in the city of Taunton, Massachusetts.

6. In addition to the previously described entrance through Narragansett Bay, a second entrance to the harbor may be obtained. This entrance, located east of Narragansett Bay, is a fairly deep

tidal strait known as the Sakonnet River. Depths in this waterway range from 20 to 40 feet. All depths mentioned in this report refer to the plane of mean low water, as established by the United States Coast and Geodetic Survey. The mean tidal range in Fall River Harbor is 4.4 feet. The locality is shown on U. S. Coast and Geodetic Charts 350 and 353, on U. S. Geological Survey Quadrangle Sheet of Fall River, and on the maps accompanying this report.

TRIBUTARY AREA

7. Fall River Harbor, situated as it is between the two deep draft harbors of Providence, Rhode Island and New Bedford, Massachusetts, would appear to have a somewhat limited tributary area. Such an appearance belies the true extent of the tributary area, which is considered to consist of an irregularly shaped area, all parts of which extend from Fall River. Within the entire area there is a population of about 1,000,000 persons. The needs of this overall region are served in part by each of several ports, such as Fall River, New Bedford, Providence, and Boston. The overlapping of the tributary areas of these ports is occasioned by the existence of two 6-inch pipelines, which are owned by the Shell Oil Company located at the head of the project, and which extend inland from Fall River. Approximately 60 percent of the total petroleum waterborne receipts of Shell Oil Corporation are handled annually by these pipelines. One of the pipelines terminates in a tank farm at West Boylston, in the vicinity of Worcester, Massachusetts. This tank farm serves a large portion of central Massachusetts, along with parts of southern New Hampshire and Vermont. The second pipeline runs to Waltham, Massachusetts serving a large portion of metropolitan Boston.

8. The immediate tributary area contains the cities of Fall River and Taunton. Both are highly industrialized communities, counting among their manufactures cotton goods, gas ranges, rubber, brass, bronze, and silver products. Such industries require the utilization of large amounts of electric power, most of which is generated in conventional fossil fuel generating plants located at the mouth of the Taunton River. The distribution area of these power plants extends over a significant part of southeast Massachusetts and eastern Rhode Island. Fuel for the plants is delivered in deep draft tankers from South American ports, or in the case of bituminous coal, colliers from Norfolk, Virginia.

9. Tiverton, Rhode Island, lies immediately south of Fall River. It is chiefly a residential town, although 4 tank farms are located within its corporate limits.

10. The area is served by the New York, New Haven, and Hartford Railroad, and a network of modern highways supplemented by a network of excellent secondary roads.

11. The approach to Fall River Harbor from the ocean is through the East Passage of Narragansett Bay and Mount Hope Bay. No bridge presently crosses the East Passage of Narragansett Bay, but there is one under construction which will connect Newport and Jamestown. This bridge will be a high-level fixed bridge with a horizontal clear span of 1500 feet and a vertical clearance of 195.4 feet. A high level suspension bridge spans the entrance to Mt. Hope Bay. It has a horizontal clearance of 1156 feet between channel piers, and a vertical clearance of 135 feet at M. H. W. for a channel span of 400 feet. This bridge was completed in 1929. In the Taunton River section of Fall River Harbor, there are 2 existing draw-bridges, and in the upper harbor area there is a fixed high level bridge. In the Sakonnet River lesser used alternative entrance to Mount Hope Bay, there are 2 bridges. Going upstream from the Atlantic Ocean, the first is a fixed highway bridge, and the second a swing railroad bridge. Pertinent data on the bridges are detailed in Table I, page 5.

PRIOR REPORTS

12. Fall River Harbor has been the subject of several navigation reports dating back to 1873. The most recent reports, which form the basis for the existing project, are described in the following table:

Document	Improvement Considered and Recommended	Action by Congress
H. Doc 158 71st Cong. 2d Sess.	30-foot channel, including Hog Is. Shoal and maintenance of the 25-foot anchorage.	Authorized R&H Act 3 July 1930
H. Doc 628 79th Cong. 2d Sess.	35-foot project depth to and along Tiverton waterfront thence to wharves above Fall River, and a 1100' x 850' turning basin at the upper end of the project.	Authorized R&H Act 24 July 1946
H. Doc 405 83d Cong. 2d Sess.	Deepening midbay channel to 35 feet for a width of 400 feet from deep water in Mt. Hope Bay to Globe Wharf in Fall River.	Authorized R&H Act 3 Sept 1954

TABLE I - BRIDGES

Name and Use	Owner	Vertical Clearance above M. H. W.	Vertical Clearance above M. L. W.	Horizontal Clearance	Type	Completed
		NARRAGANSETT BAY - EAST PASSAGE				
Newport-Jamestown	State of R. I.	195. 4' (1)	199. 8' (1)	1500' (1)	Fixed	Under Construction in 1966

(1) Clearances in navigation span are:

Hor. Dist.	Vert. Cl. above M. H. W.
1500'	195. 4'
1000'	205. 8'
Center of span	213. 0'

Name and Use	Owner	Vertical Clearance above M. H. W.	Vertical Clearance above M. L. W.	Horizontal Clearance	Type	Completed
		MT. HOPE BAY AND TAUNTON RIVER				
(2) Mt. Hope - Hwy	State of R. I.	135'	139. 4'	400' (2)	Fixed	1929
Braga - Hwy	Comm. of Mass.	136. 0'	140. 4'	400'	Fixed	1966
(3) Slades Ferry - Hwy	City of Fall River	6. 8'	11. 2'	100'	Bascule	1938
Brightman St. - Hwy	Comm. of Mass.	27. 0'	31. 4'	98'	Bascule	1914

(2) Distance between channel piers is 1156'
(3) Formerly a combination RR & Hwy Bridge (altered in 1938 for highway traffic only)

Name and Use	Owner	Vertical Clearance above M. H. W.	Vertical Clearance above M. L. W.	Horizontal Clearance	Type	Completed
		SAKONNET RIVER				
Tiverton - Hwy	State of R. I.	65. 0' (4)	68. 8'	172' (4)	Fixed	1953
Tiverton R. R.	N. Y. N. H. & H. R. R.	12. 0'	15. 8'	99'	Swing	1900

(4) Vertical clearance 56. 8 feet for 278 ft. , bridge piers 350 ft. apart.

EXISTING CORPS OF ENGINEERS PROJECT

13. The existing project provides for a channel 35 feet deep and 400 feet wide, extending from deep water in Mt. Hope Bay easterly into Tiverton lower pool, from where it branches northerly and southerly along the Tiverton waterfront. The northerly upstream limit is opposite the Gulf Oil Company wharf and the southerly downstream limit is opposite the Rhode Island Refining Company wharf. The project further provides a separate channel 35 feet deep and 400 feet wide from deep water in Mt. Hope Bay to the Globe Wharf in lower Fall River Harbor. It then proceeds with the same dimensions, increasing in width at the bends, to the Shell and Montaup wharves above the Brightman Street Bridge. It also provides for a turning basin 1100 feet wide, 850 feet long, and 35 feet deep at the upstream limit of the project. Further provisions of the existing project include the removal of ledge at the lower end of Hog Island Shoal to a depth of 30 feet; maintenance of a 25-foot anchorage, west of the upper harbor channel; and for a channel 30 feet deep east of the main harbor channel in the area extending from the vicinity of the State pier to the area below Slades Ferry Bridge.

14. The existing project, exclusive of that portion concerning the removal of rock at Hog Island Shoal, was completed in March 1959. Total costs for new work to date since the initial work in 1874 have been $4, 438, 204 and $804, 236 for maintenance. The project was last maintained in fiscal year 1963 at a cost of $465, 668. The average annual maintenance cost over the last five fiscal years has been $96, 426 and in the last ten fiscal years has been $48, 985.

LOCAL COOPERATION

15. The latest project modification, adopted in 1954, required that local interests hold and save the United States free from damages due to construction and maintenance of the additional improvement. Local interests have complied with this requirement.

OTHER IMPROVEMENTS

16. In 1955 the Commonwealth of Massachusetts completed a modern pier and storage terminal in Fall River. Expenditures for this facility total $2, 000, 000.

New Braga Bridge -- Taunton River

Taunton River looking upstream, Slades Ferry Bridge in foreground

TERMINAL AND TRANSFER FACILITIES

17. In the upper harbor there are several deep draft terminals of which two are situated in Somerset, and four in Fall River, Massachusetts. In addition, four more are located along the Tiverton waterfront in Rhode Island. A brief description of each is contained in the following subparagraphs.

Somerset and Fall River

a. In 1964 the New England Power Company completed a modern terminal which is used in connection with its new 500, 000 kilowatt conventional electrical generating station at Brayton Point in Somerset. This facility is below the harbor bridges. It has a 3300-foot long approach channel, 300 feet wide and 34 feet deep; a turning basin of about 7.5 acres; and a 150-foot wide, 1200-foot long and 34-foot deep berth at its new wharf. The wharf construction consists of 4 wood pile and timber mooring dolphins placed in a line 60 feet forward of a sheet steel pile bulkhead 750 feet long. The dolphins are connected by a pile and timber trestle, and to shore by another pile and timber trestle. Solid fill to an elevation of 17.0 feet above mean low water has been placed back of the bulkhead, and provides an area for bituminous coal storage and future oil tank construction.

b. The Montaup Electric Company located above the bridges in Somerset provides terminal facilities to handle fuel requirements for its 330, 000 kilowatt conventional electrical generating plant. It has a berth 610 feet long and 30 feet deep. Facilities for storage of 150, 000 tons of coal and 387, 000 barrels of oil are located behind the wharf.

c. Directly opposite the Montaup wharf, Shell Oil Corporation operates a modern terminal in connection with its oil distribution facility. It has a berthing space 900 feet long with a depth in excess of 30 feet. Storage capacity of its tank farm is 1, 250, 000 barrels. Two 6-inch pipelines extend from this facility, one to West Boylston in the vicinity of Worcester, Massachusetts, and the other to Waltham in Metropolitan Boston.

d. The Pacific Oil Company operates two terminals, one in the Fall River area and one in Tiverton. The first mentioned terminal is located about a mile below the Slades Ferry Bridge in Fall River. This pier is used for the receipt of petroleum products and has a storage capacity of 105, 000 barrels. It provides 35-foot berthage for 700 feet alongside a shore bulkhead.

e. The State Pier is located a short distance below Pacific Oil Co. This pier is designed for handling general cargo. It provides for a total berthing length of 1380 feet, 35 feet deep. A freight shed with dual railroad sidings is located on the upper side. The upper dock area is utilized as a permanent berth for the former battleship "Massachusetts". A 600 by 160-foot transit shed is located on the lower side. Cargo handling equipment is available. Open storage area of 15, 000 square feet is also provided.

f. Below the State Pier, opposite Borden Flats Light, the Firestone Industrial Products, Inc., pier is located. It provides berthing space of 1574 feet with depths ranging to 26 feet. It is used chiefly for the receipt of liquid latex and fuel oil.

Tiverton.

a. The Gulf Oil Corporation pier is located at the upper end of the Tiverton Channel. It has a berthing space about 600 feet long and 35 feet deep. Storage capacity of the attendant tank farm is about 350, 000 barrels.

b. Below this facility, Pacific Oil Company operates its second terminal. Total berthing space is about 600 feet long, with a depth of 34 feet. Storage capacity is 327, 000 barrels.

c. The next pier below is the Bay Oil Company. This facility is operated for the U. S. Air Force and has a berthing space 700 feet long and 35 feet deep. Storage capacity of the terminal totals 1, 200, 000 barrels.

d. The Rhode Island Refining Corporation, now owned by Paragon Oil Company, which in turn is a subsidiary of the Texas Corporation, operates a terminal immediately below Bay Oil Corporation. It has a 35-foot deep berth, 600 feet long and has a storage capacity of about 300, 000 barrels.

Pertinent data with respect to the remaining wharves are shown in the following table:

TABLE II

TERMINAL FACILITIES WITH BERTHING DEPTH LESS THAN 25 FEET BELOW MEAN LOW WATER

Pier, Wharf or Dock	Berthing Space Length (feet)	Berthing Space Depth (feet)	Use	Remarks
Fall River Gas Works Co.	200	0 to 13	Petroleum products	Storage tank capacity 20,000 bbl. Mechanical facilities for handling coal.
Globe Wharf (Staples Oil Co.)	745	8 to 23	Coal and bunkering	Storage space for 25,000 tons of coal. Mechanical facilities for handling coal. Railway siding.
Tide Water Associated Oil Co.	200	15 to 18	Petroleum products	Storage tank capacity 40,000 bbl.
Fall River City Pier	535	1 to 16	Bulk cargo	Open storage space of 25,000 sq. ft.
Joseph A. Bowen Co.	513	4 to 18	Receipt of petroleum products and mooring floating equipment.	Storage tank capacity 14,571 bbl.
Rodman Wharf (Staples Coal Co.)	1,200	0 to 15	Mooring vessels.	Wharf is occupied by four two-story brick buildings formerly used for handling coal.
City Pier	805	4 to 12	Mooring floating equipment and recreational craft.	
Fall River Electric Light Co.	627	2 to 15	Petroleum products.	Storage tank capacity 48,400 bbl.
Gladdings-Hearn Pier	240	0 to 10	Boat servicing and repair.	Marine railways and repair shop.
U.S. Naval Reserve (City of Fall River)	240	0 to 9	Mooring vessels.	Training building.

IMPROVEMENT DESIRED

18. As the specific items of local need for navigation improvement could best be obtained by a meeting of all concerned interests, a public hearing was held in Fall River, Massachusetts on 22 June 1961. Attendance at the hearing reflected the concern of all interests who have a direct connection with navigation of the waterway. The attendance included representatives of Federal, State, and municipal governments, shipping interests, terminal interests, and local citizens.

19. Several proposals were made for harbor improvement. In each case local interests claimed that existing project dimensions were inadequate for present and prospective shipping in the harbor. The specific requests follow:

a. Deepen both the "Bay" and "Tiverton" channels to 40 or 45 feet.

b. Widen both channels to a minimum of 500 feet.

c. Widen the bend leading into the channel along the north Tiverton waterfront.

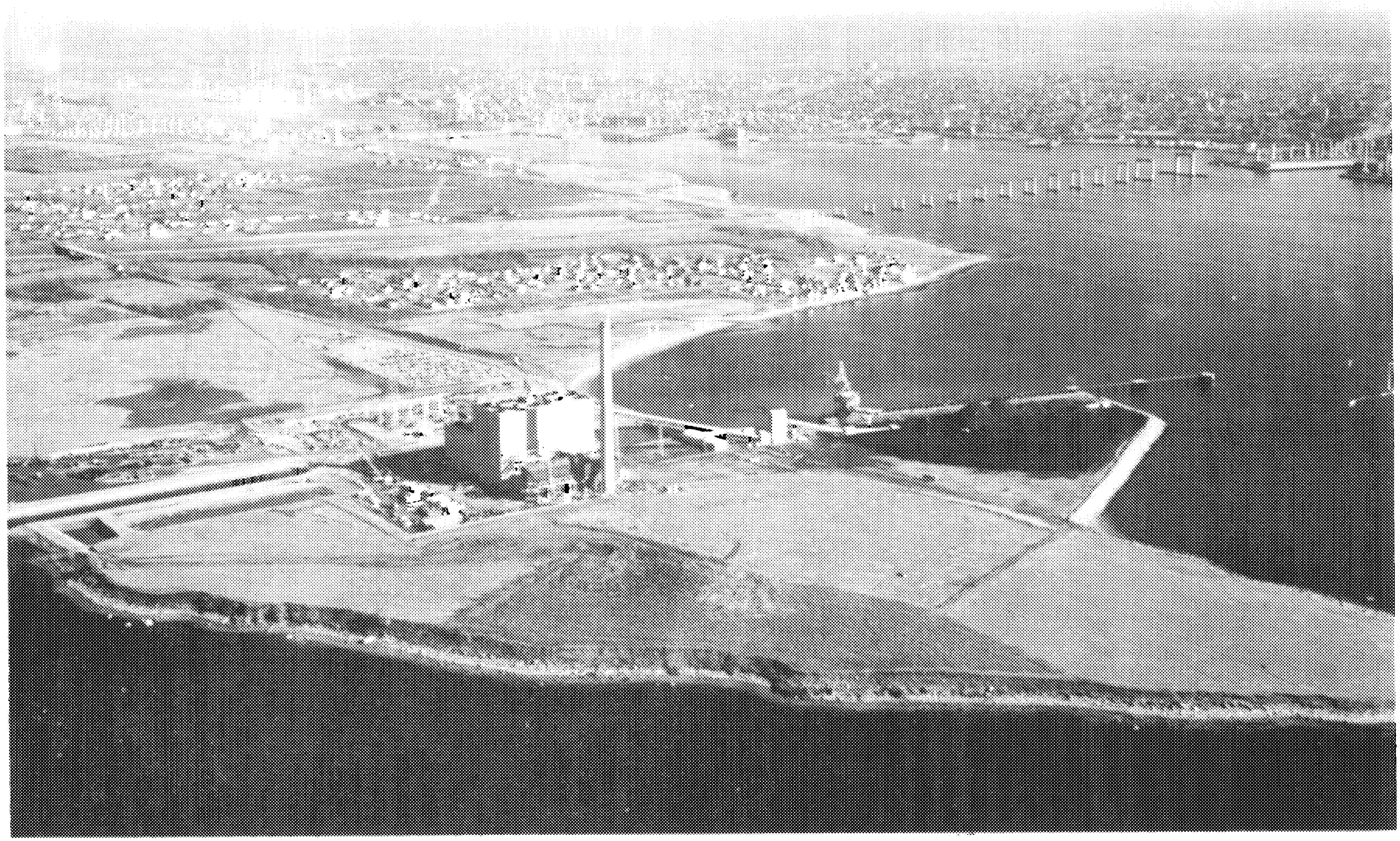
d. Provide a turning and maneuvering basin at the north end of the Tiverton waterfront, the dimensions to be 1000' x 700' x 38' deep.

e. Alter the existing Taunton River channel spans of both bridges to provide wider horizontal clearances in both spans.

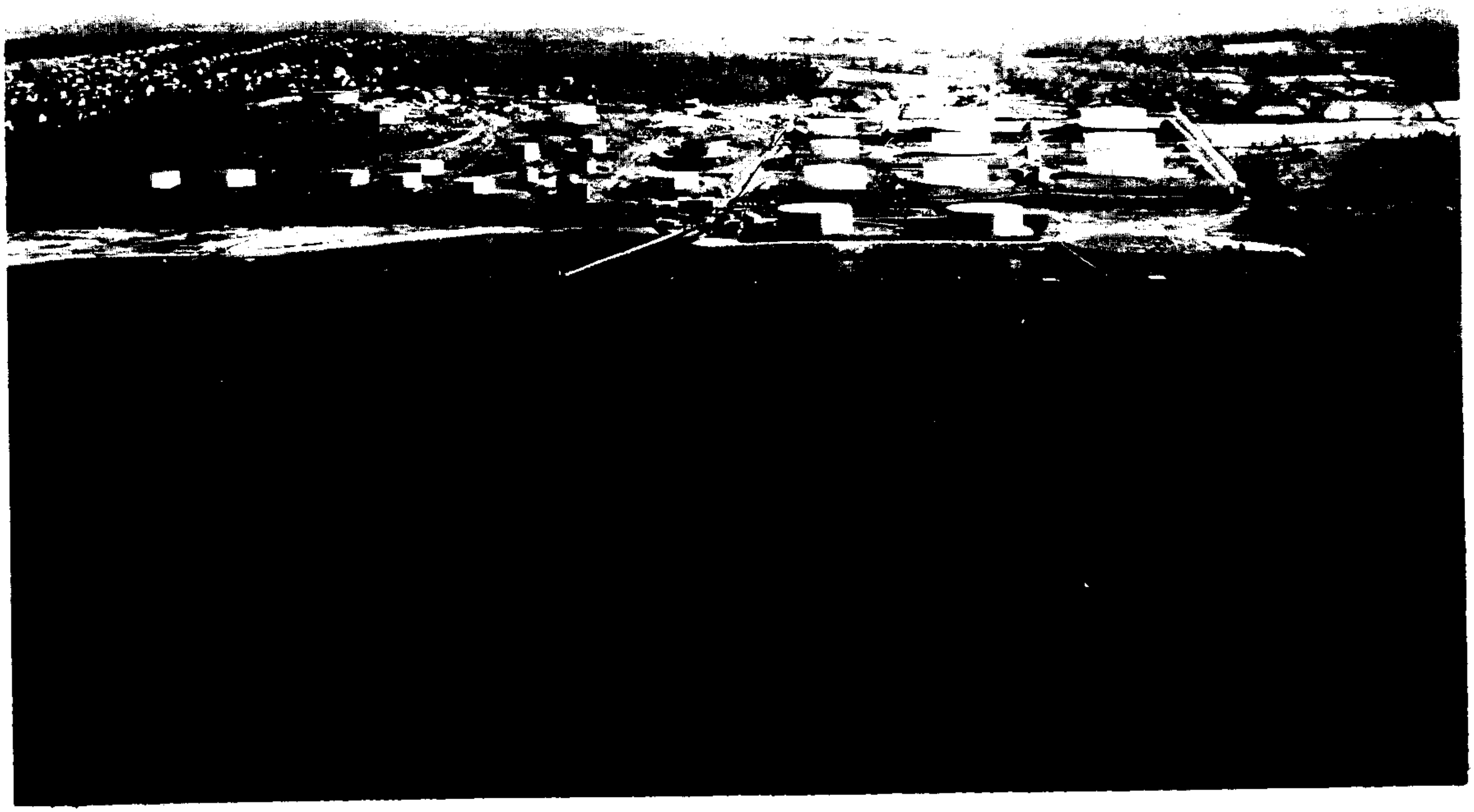
f. In lieu of altering bridges, one company requested a 40-foot depth channel to a line 1200 feet below the Slades Ferry Bridge and a suitable turning and maneuvering basin in that area.

20. In addition to the foregoing requests, the Weyerhauser Lumber Company, operator of a lumber terminal immediately south of the Mount Hope Bridge, requested improvement of the approach channel to its terminal. This channel, 75 feet wide and 29 feet deep, leads from the main natural channel to the terminal itself. Deepening of this channel to 32 feet and widening its entrance at the main channel were requested. Consideration was given to this request. It was found that the channel is used strictly for access from the main natural

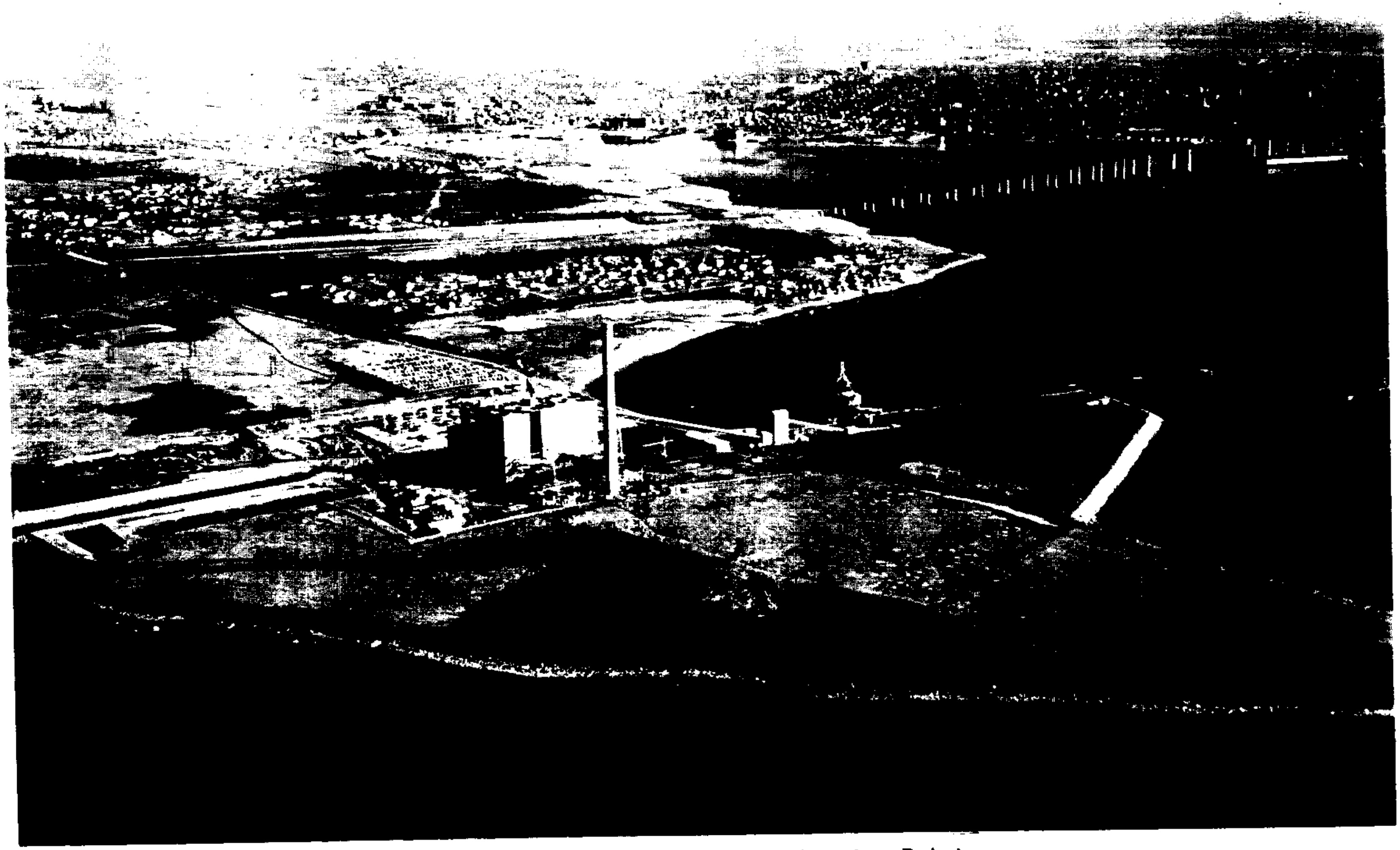
Bay and Pacific Oil Terminals -- Tiverton,R.I.



New England Power Station -- Brayton Point



Bay and Pacific Oil Terminals -- Tiverton,R.I.



New England Power Station -- Brayton Point channel to the terminal itself. Such being the case, the responsibility for this channel is an item of local rather than Federal interest. Therefore, no further consideration was given to this aspect of the desired improvement.

21. Local interests gave several specific reasons for their desires for navigational improvement. In the Fall River - Somerset area the horizontal clearances of the existing bridge drawspans are claimed to limit safe navigation to tankers no larger than Jumbo T-2's (20, 000 deadweight tons). As these vessels are 77 feet wide, it was stated that extreme care must be taken in passage through the 98-foot drawspan of the Brightman Street Bridge and the 100-foot drawspan of the Slades Ferry Bridge. Local shipping interests declare that attempting passage with a longer or wider vessel would not allow for safe navigation. Therefore, widening of the bridge drawspans was requested to allow for passage of the larger tankers, with consequent lower delivery costs of the petroleum products to the terminals above the bridges.

22. Channel widening and deepening were requested to provide adequate safe navigation for the larger tankers and colliers coming into more general use in the coastwise trade. The immediate use of 32, 000 to 40, 000 dwt tankers was indicated, should improvement be effected by provision of a 40-foot channel. Local interests cited the potential annual savings in delivery costs of petroleum products which could be attained by use of the larger tankers. These savings would be passed on to the tributary area in the form of lower power rates and fuel costs.

The requested improvements and the justification thereof are treated more fully in subsequent paragraphs.

EXISTING AND PROSPECTIVE COMMERCE

23. Fall River Harbor is essentially a receiving port. Its commerce consists largely of petroleum products, delivered from East Coast, Gulf, South American and West Indian ports. Such commerce in 1964, the latest year for which data were available for the basis of this report, constituted about 56. 9 percent of the total commerce of 3, 161, 590 tons. Coal accounted for about 42. 2 percent of the total. The remaining commerce consisted of diverse products such as crude rubber, cement, building materials, sulphuric acid, and medicines.

24. Commerce in the harbor has fluctuated in some degree during the latest 10-year period for which statistics are available. The 1964 commerce showed an increase of about 1, 148, 429 tons, or 57 percent, over the 1955 tonnage. In 1960 there was an abnormal increase of 770, 000 tons over the previous year. This commerce was mostly granite, shipped to Newport, Rhode Island for breakwater construction. It will not continue in future commerce.

TABLE III

COMPARATIVE STATEMENT OF TRAFFIC

Year	Tons	Passengers	Year	Tons	Passengers
1955	2, 013, 161	18, 136	1960	2, 942, 912	-
1956	2, 201, 989	34	1961	2, 179, 633	-
1957	2, 101, 120	-	1962	2, 599, 329	-
1958	2, 101, 916	266	1963	2, 737, 650	-
1959	2, 174, 230	1, 212	1964	3, 161, 590	-

25. A substantial increase in the annual volume of commerce for this harbor is indicated for the future. This statement is based on the nature of the tributary area and comparison with similar New England harbors, which have been recently experiencing considerable annual gains in commerce. The increased volumes of commerce are, in the main, attributable to the petroleum trade. Specifically, the gains result from new and more varied uses of petroleum products, population growth, and increased use of fuel oil for industrial purposes and domestic heating.

26. In addition to the above, there is one other factor which contributes to the growth of waterborne commerce in New England. This factor stems from the electrical power industry, which uses residual oil as well as bituminous coal for fuel. Power stations can convert readily to the use of either. As most of the residual oil is now imported, the electric utility companies endeavor to establish generating stations on deep draft waterways to avoid additional rehandling costs. The alternative fuel, bituminous coal, can also be handled more economically by water carriers. For these

reasons, and within the bounds of transmission economy, large power stations in New England are generally located on deep draft waterways. wherever possible.

27. Fall River Harbor has felt the impact of this phase of commerce. The Montaup Electric Company now operates a 330, 000 kilowatt fossil fuel plant in the upper harbor, above the bridges. This company has acquired a tract of waterfront land three-fourths of a mile south of Slades Ferry Bridge. An official of the company stated at the hearing that present planning contemplates construction of an ultimate 1, 000, 000 to 1, 500, 000 kilowatt capacity conventional fossil fuel plant. The construction of the first unit is expected to be initiated in the latter part of this decade. Another company, the New England Power Company, has completed the first 500, 000 kilowatt unit of a conventional generating plant located on Brayton Point about 1. 75 miles south of Slades Ferry Bridge. Ultimate capacity of this plant will be in excess of 1, 000, 000 kilowatts. For the first 500, 000 kilowatt plant, it is estimated that an annual average of either 810, 000 tons of coal or 610, 000 tons of fuel oil will be necessary during project life. Thus, commerce to these plants will add considerably to the overall harbor commerce, with or without harbor improvement.

28. Forecasts of petroleum demand for the year 2000 have been made by various agencies including the "American Petroleum Institute." The national per capita demand in 1961 was 22 barrels and the per capita demand in this locality 32 barrels. The Joint Economic Committee Study in Study Paper No. 13-6, December 1959, "The Adequacy of Resources for Economic Growth in the United States," estimates national demand to be 33 barrels per capita in the year 2000. Projection of this figure indicates a national per capita demand of 37 barrels in 2022. The year 2022 would be the estimated final year of project life if authorized. Similar projection of local increases indicates a per capita demand of 40 barrels. Population increases are estimated to average 2. 0 percent annually over the project life. Based on these percentages, it is estimated that the 1964 receipts to existing terminals of 1, 730, 000 tons of petroleum products in deep draft vessels will have increased to 2, 006, 800 tons by 1972 and 4, 671, 000 tons by the year 2022. In addition to this commerce, power plant commerce is expected to increase.

Investigation of New England tidewater plants for a 10-year period revealed that the use of coal versus oil has varied over a 10-year period. Oil use has predominated, ranging from 65 to 95 percent of fuel requirements. As the electrical generating plants can convert readily to the use of either fuel, the extent of use of each is governed by the economic advantage to be gained. In recent years, import quotas on residual oil have increased the use of coal for electrical generation, particularly in the case of new power stations for which quotas have been unobtainable. In all probability, import restrictions will be relaxed at some future date and the use of oil will increase gradually over project life. As the extent of such increases is not foreseeable at this time, and for the purposes of this report, future commerce to the power plants has been projected as the amount of each fuel necessary for generation of equal power requirements during project life. Thus, for the installed 830, 000 kilowatt capacity in 1972, an average of 672, 000 tons of coal and 506, 000 tons of oil will be needed for fuel. These amounts include 405, 000 tons of coal and 305, 000 tons of oil for the 500, 000 kilowatt unit of the new power plant of New England Power Company. The existing Montaup Electric power plant will, over project life, use an average of 267, 000 tons of coal and 201, 000 tons of oil. The additional 1, 500, 000 kilowatt electrical capacity when installed will average 1, 215, 000 tons of coal and 915, 000 tons of oil. The combination of existing and prospective power plant commerce totals 3, 308, 000 tons which, when added to the 4, 671, 000 tons for the existing oil terminals, will result in a total of 7, 979, 000 tons of commerce received in the 50th year of project life.

VESSEL TRAFFIC

29. In the Fall River - Somerset area, above the bridges, petroleum products are received in tankers no larger than T-2's (16, 500 dwt) or Jumbo T-2's (20, 000 dwt). Tankers of this size are small in comparison to those now used in the coastwise petroleum trade. Comparable receiving harbors in New England are presently receiving petroleum products in much larger tanker sizes. In this harbor, local interests contend that the larger size vessels are not susceptible of safe navigation through the bridges. In support of this contention, previous accidents were cited. The accidents have resulted in damages to both the bridges and the vessels involved. This navigational difficulty is considered to be solely attributable to channel widths through the bridges, as, with sufficient horizontal

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clearance, tankers ranging in size to 32,000 dwt, maximum, with a draft of 34 feet, could navigate the existing 35-foot channel at high water. In the Tiverton channel, the larger tankers are being used at the present time.

30. The 1964 vessel traffic included 143 trips of vessels, drawing 30 or more feet. Of these trips, 75 were tankers of which 33 were larger than Jumbo T-2's (20,000 dwt). The larger trips were made to the Tiverton area. In addition, the U. S. Air Force reports that its normal peacetime operations involved about 14 large vessel round trips. These vessels range in size to 250,000 bbl. capacity which is about in the 32,000 dwt class. The maximum-size vessel able to navigate this area safely is a 32,000 dwt tanker. Vessel trips of coal commerce above the bridges were confined to 11,000 dwt colliers. These vessels draw 25 to 28 feet and experience no serious navigational problems with the existing channel dimensions. The power plant below the bridge receives its coal commerce in 26,000 dwt colliers.

31. Future vessels in the bituminous coal and petroleum trades are expected to be larger with deeper drafts. The smaller colliers, mentioned in the preceding paragraph, have been supplanted by recently built super-colliers of the 24,000 to 26,000 dwt classes in deliveries below the bridges. These vessels draw 34 feet, have about the same beam as a Jumbo T-2 vessel, and carry more than twice the cargo of an 11,000 dwt collier. With these dimensions, it is considered that navigation of the existing channel could be accomplished at high tidal periods. The New England Power Company, now using coal exclusively, has indicated future use of oil in greater amounts, should present Federal import restrictions on residual oil be relaxed. This will provide for a greater incidence of tanker trips.

32. In the coastwise petroleum trade, tanker sizes are becoming increasingly larger, with consequent retirement of T-2's (16,500 dwt) and Jumbo T-2's (20,000 dwt). This facet of the trade is pronounced in the New England area as its ports are extremely distant from petroleum sources. The larger tankers, with greater cargo capacities, can deliver petroleum products more economically than the smaller T-2's and Jumbo T-2's. Evidence of this may be gleaned from comparison with a similar waterway in Boston Harbor, the Mystic River. This waterway received 3,156,000 tons of petroleum products in 1964. Of this total, about 67 percent was carried in tankers ranging from 35,000 to 46,000 dwt. The larger tankers can be used in the 35-foot Mystic

River channel as the higher tidal range of 9.4 feet, in contrast to 4.4 feet at Fall River, permits their use at high tidal periods. The incidence of larger tanker trips would have been greater had the vessels been available. Further evidence of the trend toward larger tankers may be obtained from shipyard construction records of 1965, as shown by the publication, "Maritime Reporter." As of 30 December 1965, tankers under construction in U. S. shipyards averaged 50,000 deadweight tons. The publication further gave the deadweight tonnage distribution of existing fleets of various registries in T-2 equivalents. The United States distribution, as of 31 December 1965, was 22.1 percent under 17,000, 44.7 percent ranging from 17,000 to 30,000, 23.1 percent ranging from 30,000 to 50,000, and 6.5 percent over 50,000 deadweight tons. It is evident from this distribution table that T-2 (16,500 dwt) tankers now comprise less than one-quarter of the U. S. tanker fleet, compared with the post World War II period when such vessels were the largest in the U. S. fleet. One other indication of increased tanker sizes is shown by delivery of newly constructed tankers in 1965. In that year a total of 188 new tankers were delivered to the world fleet. Average deadweight tonnage for the new vessels was 55,000 tons. This trend in larger tanker size is expected to continue. Forecasts of tanker sizes indicate that by the year 2000 the average tanker will be of these larger sizes and in use in the New England area. In the event of improvement of this harbor, it is considered that larger tankers will be introduced immediately after completion of the project, and will be used with increasing frequency during project life. This consideration is based on the long-haul distance from the ports of origin and the considerable savings to be gained by their use. It is considered that the largest tanker that will be used during project life will be in the 50,000 deadweight ton class, drawing 39 feet, fully loaded. Tankers of greater than 50,000 deadweight tons would, it is believed, be used primarily in trade to ports having greater volumes of petroleum commerce, and greater storage capacity. The dimensions and speeds of vessels expected to be used during project life are the following.

Characteristics of Ocean-Going Tankers and Colliers

Dead Weight (Long Tons)	Length (feet)	Beam (feet)	Draft	Design Speed (knots)
		Tankers		
20,000 (Jumbo)	577	77	30'-2"	14.5
25,000	577	79	33'6"	16
29,000	627	83	33'-2"	17
32,000	654	86	34'-2"	17
35,000	667	90	34'-6"	17
40,000	715	93	36'-7"	17
46,000	737	103	38'-0"	17
50,000	733	102	38'-9"	17
		Colliers		
26,000	605	75	33'-11"	16

DIFFICULTIES ATTENDING NAVIGATION

33. Navigational difficulties prevail in both sections of the harbor. In the Tiverton channel local interests claim that the existing 35-foot deep channel restricts use of the channel to the smaller vessels in the petroleum trade. At the present time the largest tanker able to navigate this channel is a 32,000 dwt tanker drawing 34 feet, loaded summer draft. A vessel of this size can navigate the channel only at high tidal periods. Shipping interests have pointed out the danger in this procedure, as any unforeseen delay could result in the vessel having to anchor in the channel until the next high water period. At best, this would delay the vessel 12 to 13 hours. Therefore, shippers hesitate to schedule the 32,000 dwt vessels for this port. In addition, the 500-foot wide

turn in the channel to the North Tiverton waterfront is extremely hazardous for the vessels, as in making the turn the danger of grounding on the banks is always present. Local interests requested a widening of this turn and deepening the channel to 40 or 45 feet to eliminate these difficulties, thus allowing for the use of larger tankers.

34. The existing 35-foot channel in Mt. Hope Bay was also cited as inadequate by local interests. Depths in the existing 35-foot channel present problems similar to the Tiverton channels. In addition, the 2 existing drawbridges in upper Fall River with horizontal clearances of 98 and 100 feet restrict the size of vessels. Current navigation to terminals above the bridges, as practiced by local shipping interests, consists of delivery of oil in tankers ranging in size from T-2's (16,500 dwt) to 20,000 dwt Jumbo-size T-2's. Such navigation is accomplished at daylight high water periods. The Jumbo T-2 has a beam of 77 feet. Thus, navigation through the 98-foot Brightman Street drawspan allows for a 10.5-foot clearance on either side of the vessel. The 32,000 dwt vessels that can and do use the 35-foot channel below the bridges have a beam of 86 feet, which would only allow for a 6-foot clearance on either side. Local interests claim that the fenders of the bridge are structurally inadequate and not intended to withstand frequent contact with the larger vessels. To support this claim, they have cited instances in which T-2's have scraped the fenders, resulting not only in damage to the fender, but to the bridge structure itself. In each case, the bridge had to be closed to both highway traffic and shipping until such time as repairs could be effected. For this reason, local shipping interests will not attempt navigation through the bridge with any vessel larger than a Jumbo T-2.

WATER POWER AND OTHER SPECIAL SUBJECTS

35. There are no matters involving water power, flood control, or related subjects concerned with this study. The required improvement would have no adverse effect on fish or wildlife as dredged spoil will not be placed on land areas. A letter from the U. S. Fish and Wildlife Service is inclosed in Appendix C.

PLAN OF IMPROVEMENT

36. In selection of a plan of improvement, consideration was given to several factors which would affect the feasibility, safety,

and practicability of future navigation in the waterway. These factors include the amount and type of future commerce, the size of vessels expected to carry future commerce, the adequacy of channels and bridge openings for the future vessels, and the most economical plan of improvement that would satisfy these conditions.

37. The improvements desired by local interests were consistent only insofar as a general deepening of the waterway was considered necessary for future vessel traffic. The specific improvements requested consist of:

a. Deepening both waterways to 40 or 45 feet.

b. Widening the Mt. Hope Bay channel from 400 to 500 feet.

c. Providing a turning basin opposite Gulf wharf on the Tiverton channel.

d. Deepening and widening the approach channel into the Atlantic Terminal below the Mt. Hope Bridge.

e. Replacement of Slades Ferry Bridge and widening the drawspan of the Brightman Street Bridge.

All of the improvements were requested to enable the use of the larger tankers and colliers.

38. Design of channel depth is predicated on ship draft plus proper allowances for safe navigation. In this locality a 5-foot clearance between the bottom of the hull and the channel bottom is considered necessary. The 5-foot clearance is composed of several factors which require consideration. These factors include squat or scend (pitch) of vessels when underway; uneven loading, due in some cases to fuel consumption at the end of a long voyage and in others to the difficulties inherent in loading oils of different specific gravities in the same vessel; adequate hull and propeller clearance for steerageway; and the character of bottom materials. Ships underway are subject to a condition known as squat. This condition results from the effects of a bow wave pushed up in front of the vessel underway. The hull of the vessel sinks in the following trough adding to the draft. In this

channel a maximum allowance of 1 foot was included for this factor. An allowance of 1 to 2 feet was made for uneven loading. In addition to these features some clearance between the channel bottom and the hull is necessary to avoid sucking of materials in the propeller and for adequate steering. The commonly accepted clearance requirements in this category for large vessels are 2 to 3 feet, minimum. The sum of these factors indicates a 5-foot clearance is necessary for all vessels. Channel design and computation of tidal delays included this 5-foot factor.

39. Studies of 37-, 38-, 40-, and 45-foot channel depths were made. In each of these channels it was found that considerable savings could be effected by the use of larger tankers. With the necessary hull clearance and a mean tidal range of 4.4 feet, it was found that the 37-foot channel would allow for a maximum-sized tanker of 35,000 dwt. For the 38-foot channel, a 40,000 dwt tanker would be maximum and for the 40-foot channel, a 50,000 dwt tanker, all at high tidal periods. It is not believed that larger than 50,000 dwt tankers would be used in the Fall River trade. Therefore, no benefit for such larger ships was estimated. However, a 45-foot channel would result in elimination of tidal delays that would be incurred in using a 40-foot channel by all tankers in excess of 35,000 dwt. The incremental savings in the 40-foot channel would outweigh considerably the savings to be attained in the other channels and provide for navigation of the larger vessels, which will be available during project life. The 45-foot channel was not found economically justified, therefore the 40-foot channel was selected in the overall plan of improvement. Future coal colliers can now use the 35-foot channel at high water periods. In the 40-foot channel these vessels will be able to navigate at any time, and costly tidal delays will be eliminated. Details of the 37-, 38- and 45-foot channels are shown in Appendices A & B.

40. Channel widening was considered for the larger vessels. It was found that the present 400-foot width would accommodate the larger vessels safely. The 50,000 dwt tankers have a beam of 102 feet. The 102-foot beam would allow for a margin of 298 feet or 149 feet on either side of the vessel. This margin would be ample for any irregularities in steering or windage. Further, as the port operation is such that only one of the larger ships would be transiting the channel at any specific time, it is considered that further widening is unnecessary at this time. The 400-foot width will provide a somewhat lower cross-sectional ratio of hull to channel area than recommended in the Panama Canal studies of channel widths. However, it is considered that with the exercise of good seamanship and reasonable caution, the existing channel width will suffice for the needs of future shipping. As tankers are turned upriver of the bridges before unloading, due to the difficulty and hazard in turning unloaded tankers riding high and much more subject to wind forces, the entire maneuvering area and turning basin at the upper end of the project must be deepened to the 40-foot depth.

41. At the inception of the study, it became apparent that improvement of the entire waterway, as desired by local interests could not be accomplished without bridge alteration to provide for wider drawspans. The wider drawspans are necessary to accommodate the longer and broader beamed tankers bound to the terminals upstream of the bridges. During the study it appeared that a more economical solution might entail construction of a ship unloading terminal downstream and piping the products upstream. Investigation of this aspect of the problem revealed that pipeline construction would be less economical than bridge alteration. This condition evolves from two sources. First, all of the petroleum commerce to the power station, and a considerable portion of commerce to the oil terminal,consist of residual fuel oil. This oil has a high viscosity and does not lend itself readily to pumping, particularly at temperatures below 60 degrees. To pump this product it is necessary to heat the pipeline in order that the product may flow readily. This is usually accomplished by enclosing the fuel line in a larger insulated pipe and forcing steam between the two pipes. Construction of a steam plant would be required, adding to the high costs of installing of the pipeline. It was found also that with the completion of the new, high-level fixed Braga Bridge, demolition of the Slades Ferry Bridge is being contemplated. In such case, alteration of the Brightman Street Bridge only would be required. It has been found that alteration of this bridge would be more economical than the pipeline method. Therefore, the bridge owner has been notified that the present structure is unduly restrictive to safe navigation and will require alteration in the event of improvement. On this basis the Truman-Hobbs Act will apply. Details of application of the costs are shown in Appendix A.

42. For navigation purposes, a minimum horizontal clearance of 300 feet in the drawspan should be provided. As the vessels have tugboat assistance in negotiating the drawspan, this width would give ample room for the largest vessel to be used in future navigation. The largest vessel for which the 40-foot channel is needed has a beam of 102 feet. For the 300-foot drawspan, a double leaf bascule bridge is necessary. To alter the bridge as described, it is estimated that the Brightman Street Bridge would involve costs of $3,675,000 of which $497,000 would be incurred by local interests and $3,178,000 by the Federal Government, as provided by terms of the Truman-Hobbs Act.

43. Investigation of the need of a turning basin in the vicinity of the Gulf wharf revealed that such a basin would serve only one terminal. It was found, further, that while the basin would be convenient in the area, its construction costs would not be economically justifiable. The sole purpose of the basin would consist of turning vessels around in order that they could proceed outbound after discharge of cargo. It is considered that this maneuver could be accomplished with reasonable precaution by towing to the Tiverton Lower Pool where there is ample room for such procedure.

44. Improvement of the Tiverton channel would include a 5-foot deepening of the existing 35-foot channel to Gulf wharf, widening the bend, and providing a 400-foot wide by 40-foot deep channel to the vicinity of the Rhode Island Refining Corporation wharf.

SHORELINE CHANGES

45. The existing channels have been deepened in successive increments to 35 feet. No adverse effects have resulted from these deepenings. As no channel widening is proposed in the vicinity of the shorelines, no adverse effect would result from the harbor improvement.

REQUIRED AIDS TO NAVIGATION

46. The United States Coast Guard has been consulted relative to additional aids to navigation should the proposed improvement be constructed. The agency has stated that no additional aids would be necessary.

ESTIMATES OF FIRST COSTS

47. Estimates of first costs have been prepared separately for each section of the harbor and combined to show the overall first cost of improving the entire waterway. Probings taken in 1961 and 1962 and past dredging experience indicate the bottom materials to be mud, clay, sand and gravel. Past dredging experience in the Tiverton channel indicates some boulder areas, which can be removed by bucket dredging. Quantities are in terms of in-place measurement and include a 2-foot overdepth allowance. Allowable side slopes are 1 vertical on 3 horizontal. The nature of bottom materials and the

steep slopes and highly developed character of the surrounding terrain preclude the use of hydraulic dredges on this project. Therefore, the dredging will be accomplished by bucket dredge with disposal at sea. Dredging costs are based on recent experience in similar areas and reflect prices current in November 1966. Estimates of the 37-, 38-, and 45-foot channels are detailed in Appendix "A". Estimates of bridge alteration costs and pipeline alternative are also shown in Appendix "A".

Estimate of Costs

40-foot channel construction costs

Federal First Cost		
Mt. Hope Bay Channel		
Dredging	$2, 999, 200	
Contingencies (15%)	449, 800	
	$3, 449, 000	
Engineering and Design	120, 000	
Supervision and Administration	141, 000	$3, 710, 000
Tiverton Channel		
Dredging	$1, 495, 000	
Contingencies (15%)	224, 000	
	$1, 719, 000	
Engineering and Design	60, 000	
Supervision and Administration	95, 000	$1, 874, 000
*Bridge Alteration (Brightman Street)		$3, 178, 000
Total Federal First Cost		$8, 762, 000
Non-Federal First Cost		
*Bridge Alteration		$ 497, 000
TOTAL PROJECT COST		$9, 259, 000

*Includes Engineering & Design, Supervision and Administration.

ESTIMATE OF ANNUAL CHARGES

48. Annual charges for the proposed 40-foot project have been computed on the basis of an assumed 50-year life and at an interest rate of 3.125 percent for all investments. Additional annual maintenance costs are based on experienced shoaling in the existing channels with adjustments made to reflect the dimensions of the proposed channels.

Annual Charges (40' Project)

Federal	Mt. Hope Bay	Tiverton	Bridge Alteration
Interest and Amortization	$147,600	$74,600	$146,200[1]
Additional Annual Maint.	19,400	4,400	-
	$167,000	$79,000	$146,200

[1] Includes local annual charges of $19,700 for bridge alteration.

Details of annual charges for alternative channels are shown in Appendix A.

ESTIMATES OF BENEFITS

49. Improvement of the waterway will enable the tributary area to realize considerable benefits during project life. The benefits will be derived from the ability to transport waterborne commerce more economically than in the existing project. The economies to be derived will evolve from three sources of transportation savings. The first and major source will be found in the ability to navigate the waterway with larger vessels than those in current use. The second source will originate with the reduction or elimination of tidal delays to which a portion of the existing vessel traffic is now subject. The third and final source, considered in this report, will be derived from a reduction in annual towboat costs. Each of these types of savings is discussed in greater detail in this section.

50. In the waterborne petroleum trade, per-ton delivery costs of the commodities become proportionally lower as the size of the carrier increases. For example, total round trip costs of a 32,000

dwt tanker from Gulf ports average $71, 000 for this harbor. This type of tanker can deliver 34, 300 short tons to the port. Under the same conditions, round trip costs of a 40, 000 dwt tanker are $82, 700 and 42, 850 short tons are carried. These trip costs are computed on hourly costs of the class of ship, and the time involved in the round trip. Thus, it may be seen the delivery cost per short ton in the 32, 000 dwt vessel is $71, 000 ÷ 34, 300, or $2. 07. Similar per ton costs for the 40, 000 dwt tankers are $82, 700 ÷ 42, 850, or $1. 93. Computation for 50, 000 dwt tankers reveals a delivery cost of $1. 69 per short ton. All of the foregoing costs are based on the premise that the vessels could proceed into the harbor and deliver cargo. In point of fact, and as shown previously, the 32, 000 dwt vessels are the largest that can be used in the existing 35-foot channels. Therefore, benefits for deepening the existing channels are predicated on the incremental savings in delivery costs to be attained by providing for the use of the larger tankers. In addition, it should be noted that benefits are computed for only that portion of the petroleum commerce which is received in large, oceangoing deep-draft vessels.

51. Benefits to be realized from improvement differ in scope and application. This condition results from dissimilar navigational conditions in the upper and lower harbors. In the lower harbor the maximum-sized tanker used is a 32, 000 deadweight ton type. Maximum for the upper harbor is a 20, 000 deadweight ton (Jumbo T-2) type. The reason for this difference lies in the horizontal clearances of the bridge drawspans. Since the larger 32, 000 deadweight ton vessels could proceed through a wider drawspan with existing 35-foot channel depths, the transportation savings to be achieved by use of them, in lieu of 20, 000 dwt vessels, are allocated as benefits to bridge alterations only. Benefits for channel deepening will be derived from the transportation savings to be achieved by the use of larger than 32, 000 deadweight ton vessels.

52. As stated previously in the section, Vessel Traffic, the largest vessel that will be used in this harbor is a 50, 000 dwt tanker. As these vessels, comprising only about 6 percent of the 1965 U. S. tanker fleet, are not readily available at this time, their use will not become general immediately after improvement. However, vessels of this class are being constructed in greater numbers and, in view of the savings to be attained by their use, they will be introduced into this harbor's commerce shortly after improvement, and used with increasing frequency during the remainder of project life.

On this basis, it is estimated conservatively that in the final year of project life at least 50 percent of the petroleum products receipts will be delivered in the 50, 000 dwt vessels and the remainder in a combination of smaller vessels, ranging in size from 32, 000 to 46, 000 dwt.

53. Benefits to be realized from the savings in transportation costs, described above, were derived from both foreign and domestic commerce and will vary throughout project life. Therefore benefits were computed for both the years 1972 and 2022 which are considered to be the first and final years of project life. The annual benefits to be realized in 1972 will carry through the entire project life. The benefits to be realized in 2022 were computed for the petroleum receipts anticipated for that year. The difference between the benefits for the two years was reduced to an average annual equivalent at a 3-1/8 percent interest rate and taken as annual benefits.

54. Computation of navigation benefits in the delivery of petroleum products above the bridge due to channel deepening consist of savings to be achieved by larger than 32, 000 deadweight ton vessels for total petroleum receipts. To illustrate this particular benefit derivation, the following computation is shown. Domestic petroleum commerce in the Bay channel above the bridges is anticipated to total 1, 030, 000 short tons in 1972 and 2, 398, 000 short tons in the year 2022. Should this latter tonnage estimated for the year 2022 be carried in 32, 000 dwt tankers, the total delivery costs at $2. 07 per ton would amount to $4, 964, 000. In a 40-foot channel, the commerce could be carried in a combination of 50, 000 dwt and smaller tankers. The portion to be carried in the 50, 000 dwt tankers is estimated to be 50 percent of the total, or 1, 199, 000 tons. Per ton delivery costs are $1. 69. The total costs for delivery of this portion would therefore amount to $2, 026, 300. As the remaining portion would be carried in smaller tankers, and in the interests of conservatism, it was decided to use an average tanker size below that which is actually predicted to be average size for that year. Tanker size selected for that year was 35, 000 dwt. Delivery costs for this size tanker are $1. 96 per ton. Total costs for delivery of the remaining 1, 199, 000 tons of commerce on this basis would be $2, 350, 000. This sum combined with the $2, 026, 000 delivery costs for the 50, 000 dwt tankers amounts to $4, 376, 000, total delivery costs for the combination of larger tankers. Comparison of the total costs for the larger tankers with the cost for delivery by 32, 000 dwt tankers reveals a

total savings of $588, 000. These savings would be realized in the final year of project life and represent the highest annual total of an ever increasing amount of savings over project life due to channel deepening. Savings for the 1972 commerce were computed in the same manner and amount to $113, 000. The future savings (year 2022) include the annual savings expected to be realized immediately after improvement. The difference between the two figures amounts to $475, 000, which, reduced to its annual average equivalent, is $184, 000, an average annual benefit to improvement. The total average annual benefit over the project life would be $113, 000 + $184, 000, or $297, 000. As these benefits thus computed were for domestic shipping, 50 percent of them were allocated to the ports of origin. Similar benefit computations were made for foreign commerce and for the Tiverton Channel. The petroleum commerce benefit computations for the 40-foot channel are shown in Table No. 4 and summarized in Table No. 5. Similar computations for 37-, 38-, and 45-foot channels are shown in Appendix B.

TABLE IV

BENEFIT COMPUTATION (OIL)
40' vs 35' Channel
Bay Channel (above bridges)

Tanker Class dwt	35-Foot Channel: Oil Receipts Sh. Tons (1000)	35-Foot Channel: Delivery Cost/Sh Ton $	35-Foot Channel: Total Costs $(000)	40' Foot Channel: Oil Receipts Sh. Tons (1000)	40' Foot Channel: Delivery Cost/Sh. Ton $	40' Foot Channel: Total Costs $(000)	Diff vs 35' Channel $(000)	Increase 1972-2022 $(000)	Annual Average Equivalent Factor 3.125%	Annual Benefits 1972 $(000): Bridge	Annual Benefits 1972 $(000): Channel	Annual Benefits 1972 $(000): Total	Annual Benefits Over Project Life 1972-2022: Bridge	Annual Benefits Over Project Life 1972-2022: Channel	Annual Benefits Over Project Life 1972-2022: Total
DOMESTIC															
1972															
20.000	1030	2.63	2709												
32,000	1030	2.07	2132												
35,000				1030	1.96	2019	113								
Diff w/bridge widening			577							577	113	690	577	113	690
2022															
20,000	2398	2.63	6306												
32.000	2398	2.07	4964												
Diff w/bridge widening			1342					765	0.3866				296		
35,000				1199	1.96	2350									
50,000				1199	1.69	2026									
						4376	588	475	0.3866					184	480
FOREIGN															
1972															
20.000	563	1.53	861												
32.000	563	1.25	703												
35,000				563	1.20	676	27								
Diff w/bridge widening			158							158	27	185	158	27	185
2022															
20,000	1042	1.53	1594												
32,000	1042	1.25	1302												
Diff w/bridge widening			292					134	0.3866				52		
35.000				521	1.20	625									
50,000				521	1.05	547									
						1172	130	103	0.3866					40	92
Commerce Above Bridges - Total Benefits										735	140	875	1083	364	1447
COMMERCE BELOW BRIDGES (FOREIGN)															
1972															
32,000	305	1.25	381												
35,000				305	1.20	366	15			-	15	15	-	15	15
2022															
32,000	1220	1.25	1525												
35.000				610	1.20	732									
50.000				610	1.05	641									
						1373	152	137	0.3866				-	53	53
Commerce Below Bridges - Total Benefits										-	15	15	-	68	68
TIVERTON CHANNEL															
1972															
32,000	615	2.07	1273												
35,000				615	1.96	1205	68			-	68	68	-	68	68
2022															
32,000	1431	2.07	2962												
35.000				715	1.96	1401									
50,000				716	1.69	1210									
						2611	351	283	0.3866				-	109	109
Commerce Tiverton Channel - Total Benefits										-	68	68	-	177	177
Commerce Entire Project - Total Benefits										735	223	958	1083	609	1692

55. Savings in transportation costs will also result from the elimination of tidal delays to future coal commerce. Savings will also be derived in the same manner as for petroleum commerce. The tanker tidal delay costs have been included in computation of net per-ton delivery costs described in previous paragraphs. Therefore, no separate computation is shown for tanker tidal delays.

56. Tidal harbors provide for deeper draft navigation than project depths appear to indicate. Project depths in the existing channels in this harbor are 35 feet. This depth would restrict navigation to a vessel with a maximum draft of 30 feet. As the tide rises, safe drafts of vessels increase so that with a tidal range of 4.4 feet a vessel drawing 34.4 feet can navigate the waterway safely at high water. Since the vessels drawing more than 30 feet require a tidal height commensurate with their draft, they are at times forced to wait until such time as there is sufficient tide to navigate the waterway. These waiting times are commonly called tidal delays and result in higher transportation costs for the commodities carried. The higher transportation costs reflect the hourly operating costs of the vessels incurred in waiting for favorable tides.

57. In the past, bituminous coal was carried into this harbor in coal colliers ranging in size from 8500 to 12,500 deadweight tons. This commerce is changing. New super-colliers have been introduced into the trade and will be used exclusively in the future. The vessels range from 24,000 to 26,000 dwt and are able to deliver bituminous coal more economically than the smaller vessels. The New England Power Company now uses the vessels for its coal needs. As the colliers draw 34 feet, and have a beam of 76 feet, navigation of the existing channel to and above the bridges is possible only at high water periods. Future coal commerce would be subject to tidal delays which could be eliminated by improvement of the channel. Using mean tidal curves for the locality, the average tidal delay for a vessel drawing 34 feet was found to be 4.9 hours in the 35-foot channel, and 0.0 hours in the 40-foot channel. The hourly operating cost of the vessel is \$216. Average delay costs are 4.9 x \$216 or \$1,058. The vessels carry 26,000 short tons. Total average tidal delay cost is therefore \$1058 ÷ 26,000 or \$0.04 per short ton, which, if eliminated, results in a benefit for improvement. The 1972 coal deliveries to the power plant below the bridges will total 405,000 tons of coal. Savings for this commerce by delivery in super colliers amount to \$0.04 x 405,000 or \$16,200, an average annual benefit. Average annual coal commerce to

the existing Montaup plant above the bridge is 267, 000 tons. Annual benefits from this source total $10, 600. Future coal deliveries to the power plants below the bridges in the year 2022 will total 1, 620, 000 tons which represent an increase of 1, 215, 000 tons over the 1969 commerce. Savings for this increase in commerce would be 1, 215, 000 x $0. 04 or $48, 600. Reduced to its annual average equivalent, this figure becomes $18, 800, incremental average annual benefits. The total annual benefits to be realized in this manner amount to $45, 600, all attributable to the Bay Channel.

58. Further benefits can be realized from reduction in annual towboat costs. The reduction results from the number of vessel trips which will be necessary to carry the annual volume of petroleum commerce. To illustrate this fact, the petroleum commerce in year 2022 is estimated to total 4, 661, 000 tons in the Bay channel. Without improvement, the commerce would be carried in 32, 000 dwt tankers. These vessels have a net cargo capacity averaging 34, 300 short tons, and could carry the annual petroleum commerce in 136 vessel trips. After improvement, the same amount of commerce could be carried in a combination of 35, 000 dwt and 50, 000 dwt vessels trips with average cargo capacities of 37, 000 and 54, 000 short tons, respectively. If it is assumed that 50 percent of the total commerce were carried in each class, it would require 62 trips of the 35, 000 dwt vessels and 43 trips of the 50, 000 dwt vessels for a total of 105 vessel trips to carry the same commerce. As 31 less vessel trips would be required with an improved channel, the cost of towboat services for that number of trips would be eliminated after improvement. Towboat services per vessel trip in this area of the harbor average $1240 for docking and undocking. Total savings for the 31 trips would be $38, 440. This amount, reduced to its annual average equivalent is $14, 900 which is considered an annual average benefit for the petroleum commerce over the 50 year project life. Benefits for reductions in annual towboat costs were computed in similar fashion for the Tiverton channel and amount to $6, 000 average annual benefits.

59. The petroleum benefits are summarized in Table No. 5. Total benefits for the 40-foot channel are summarized in Table No. 6.

TABLE V

SUMMARY OF BENEFITS

Petroleum Commerce

Year	Domestic	Foreign	Total
	Bay Channel (40 feet)		
1972	$113,000	$42,000	
1972-2022	184,000[1]	93,000[1]	
Sub-total	$297,000		
50% to Ports of Origin	-148,000		
Total	$149,000	$135,000	$284,000
	Tiverton Channel (40 feet)		
1972	$ 68,000		
1972-2022	109,000[1]		
	$177,000		
50% to Ports of Origin	-88,000		
	$ 89,000		

[1] Average Annual Equivalent

TABLE VI

SUMMARY OF ALL BENEFITS

Benefits from Channel Deepening to 40 Feet

	Oil	Coal	Reduction in Towboat Costs	Total
Bay Channel	$284, 000[1]	$45, 600	$14, 900	$344, 500
Tiverton	89, 000[1]	-	6, 000	95, 000
Combined	$373, 000[1]	$45, 600	$20, 900	$439, 500

[1] 50% allocated to port of origin (Table 5)

Benefits from Bridge Alteration
(Accrues to Oil Commerce Only)

Year	Domestic	Foreign	Total
1972	$577, 000	$158, 000	$735, 000
1972-2022	296, 000[1]	52, 000[1]	348, 000[1]
Sub-total	$873, 000	$210, 000	$1, 083, 000

[1] Average Annual Equivalent.

Total Benefits for Improvement (Combined Project)	$1, 523, 000

PROJECT FORMULATION AND MAXIMIZATION OF BENEFITS

60. For purposes of project formulation with resultant maximization of benefits, several plans of improvement were studied. Each of the plans considered navigation improvement from the standpoint of channel depths and widths. Four channel depths were studied with costs and benefits evaluated for each depth. Channel widths, except in the vicinity of the bridges, are adequate for present and prospective shipping. To correct the navigational inadequacy in the vicinity of the bridges, 2 plans were studied. The first considered widening of the bridge drawspans and deepening the existing channel and basin throughout. The second plan consisted of terminating channel improvement at a line 3500 feet below the lower bridge, and providing a maneuvering basin at this upper end of the improved channel. Terminal operators above the bridges would be required to install receiving wharves in the vicinity of the basin, downstream of the bridges, and construct pipelines to their present terminals. Comparable costs and benefits are tabulated below and shown separately for each plan.

(See Table VII on following page)

TABLE VII

BENEFIT - COST COMPARISONS
(Channel Deepening Only - Exclusive Bridge Costs or Benefits)

	37-Foot Channel	38-Foot Channel	40-Foot Channel	45-Foot Channel
BAY CHANNEL (To Terminals above Bridges)				
Benefits	$187, 000	$225, 000	$344, 500	$356, 000
Costs	129, 000	137, 000	167, 000	360, 000
B/C Ratio	1. 4	1. 6	2. 1	1. 0
Excess Benefits	58, 000	88, 000	177, 500	-
TIVERTON CHANNEL				
Benefits	$ 51, 000	$ 60, 000	$ 95, 000	$ 99, 000
Costs	39, 000	50, 000	79, 000	190, 000
B/C Ratio	1. 3	1. 2	1. 2	0. 5
Excess Benefits	12, 000	10, 000	16, 000	-
COMBINED PROJECT (Deepening Only)				
Benefits	$238, 000	$285, 000	$439, 500	$455, 000
Costs	168, 000	187, 000	246, 000	550, 000
B/C Ratio	1. 4	1. 5	1. 8	0. 8
Excess Benefits	70, 000	98, 000	193, 500	-

BENEFIT-COST COMPARISON - UPPER END PROJECT ONLY
(Channel Widening Through Bridge, No Channel Deepening)

	BRIDGE ALTERATION	PIPELINE ALTERNATIVE
Benefits	$1, 083, 000	$1, 083, 000
Costs	146, 200	160, 000
B/C Ratio	7. 4	6. 8
Excess Benefits	936, 800	923, 000

BENEFIT-COST COMPARISON - TOTAL PROJECT
(Including Either Bridge Alteration or Pipeline Alternative)

	37-Foot Channel	38-Foot Channel	40-Foot Channel	45-Foot Channel
BRIDGE ALTERATION (Including Channel Deepening Entire Project)				
Benefits	$1, 321, 000	$1, 368, 000	$1, 522, 500	$1, 538, 000
Costs	314, 200	333, 200	392, 200	696, 200
B/C Ratio	4. 2	4. 1	3. 8	2. 2
Excess Benefits	$1, 006, 800	$1, 034, 800	$1, 130, 300*	$ 841, 800
PIPELINE ALTERNATIVE (Channel Deepening to Basin at Bridges, and Pipeline above Bridges)				
Benefits	$1, 321, 000	$1, 368, 000	$1, 522, 500	$1, 538, 000
Costs	328, 000	347, 000	406, 000	710, 000
B/C Ratio	4. 0	3. 9	3. 8	2. 2
Excess Benefits	$ 993, 000	$1, 021, 000	$1, 116, 500	$ 828, 000

*Recommended Improvement.

NOTE: Because of assumption that 50, 000 DWT tankers are largest vessels that will use Fall River Harbor, the only benefits that would accrue would be reduction and elimination of tidal delays, up to a maximum annual value of $15, 500. The annual cost per foot of channel deepening below 40 feet is about $60, 000. Therefore the 40-foot channel provides the maximum benefits.

The foregoing tables show that for channel deepening the maximum incremental excess of benefits can be obtained in the 40-foot plan, both in Tiverton and in the Bay channels. Therefore, this plan was adopted. In the plans for channel widening through the bridges, benefits are the same for either bridge alteration or pipeline construction, with higher annual costs for the pipeline alternative. Therefore bridge alteration was adopted in the overall plan of improvement. The total plan provides for the maximization of net benefits.

COMPARISON OF BENEFITS AND COSTS

61. Comparisons of annual benefits to annual costs for each feature of the proposed 40-foot deep channel are detailed below. The annual benefits and annual costs are based on an anticipated project life of 50 years. Costs include both Federal and non-Federal costs.

	Annual Benefits	Annual Costs	Benefit-Cost Ratio
Bay Channel	$344, 500	$167, 000	2. 1
Tiverton Channel	95, 000	79, 000	1. 2
Bridge Alteration	$1, 083, 000	146, 200	7. 4
Combined Project	$1, 522, 500	$392, 200	3. 9

PROPOSED LOCAL COOPERATION

62. The benefits to be derived from improvement of the waterway will be general in nature. In view of such general benefits, it is considered that no local cash contribution toward the first cost of construction should be required. However, it is considered that as items of cooperation local interests should:

a. Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and maintenance of the project.

b. Hold and save the United States free from damages due to construction of the project.

c. Make such alterations to underwater utilities as necessary to enable full realization of the project benefits.

d. Improve berths and access channels to a depth commensurate with project depth.

e. Remove the existing Slades Ferry Bridge.

f. Alter or reconstruct the Brightman Street Bridge, assuming a share of the costs in accordance with the principles of the Truman-Hobbs Act.

Reasonable assurances of fulfillment of the above requirements have been received.

63. Due to the nature of the materials and the lack of available land disposal areas, it is anticipated that dredging will be accomplished by bucket dredge, with dredged materials spoiled at sea. (See Par. 47).

COORDINATION WITH OTHER AGENCIES

64. All Federal, State and local agencies concerned with development of the waterway were notified of the public hearing held at Fall River, Massachusetts, 22 June 1961. Subsequently, discussions were held with representatives of the Commonwealth of Massachusetts, State of Rhode Island, City of Fall River, the Town of Tiverton, R. I., the New England Power Company, the Montaup Electric Company and the various terminal and shipping interests. Conferences on bridge alteration were held with representatives of the Massachusetts Department of Public Works, which furnished bridge alteration estimates. The U. S. Fish and Wildlife Service was consulted on the study and its conclusions. Fish and Wildlife reports are contained in Appendix C.

DISCUSSION

65. Fall River Harbor is situated in southeastern Massachusetts and eastern Rhode Island. Similar to most harbors in the New England area, it is chiefly a receiving port. The chief item of commerce consists of petroleum products, which in 1964 accounted for 56.9 percent of the total commerce of 3,161,590 tons. Second to this commerce was bituminous coal which accounted for 42.2 percent of the same total. Petroleum commerce was received from either Gulf, South American or

West Indian ports. Waterborne shipments from the port totalled 32,027 tons. Bituminous coal originates in either western Pennsylania or West Virginia, from where it is shipped by rail to Norfolk, Virginia, and then transshipped by coal collier to this locality. The harbor commerce has been increasing steadily over the last 10-year period. The 1964 commerce is 57 percent greater than the 1955 commerce.

66. Present bituminous coal carriers serving Fall River Harbor range from 8,500 dwt to 11,000 dwt vessels. Petroleum commerce is presently carried in tankers ranging in size from T-2's (16,500 dwt) to 32,000 dwt. The use of T-2's and the slightly larger Jumbo T-2's has predominated in the Bay channel. The restriction against use of the larger tankers to the upper harbor terminals, according to local interests, results from inadequate horizontal bridge clearances in the Fall River-Somerset area. Eighteen trips of larger than Jumbo T-2's were made to commercial oil terminals in the Tiverton area in 1964. In addition, 14 trips of deep draft tankers, the largest of which was a 32,000 dwt tanker, were made to the U. S. Air Force terminal in Tiverton.

67. In recent years there has been a pronounced trend toward the use of larger tankers and coal colliers. As the larger vessels can deliver the cargoes at a lower cost per ton, local interests desire navigational improvement, on the basis that the larger vessels would be used should improvement be effected. The claim appears to be reasonable as the larger vessels are presently being used with greater frequency in comparable New England harbors. After study of navigational conditions, it was found that improvement was necessary for future commerce. The plan found most economically feasible consists of deepening the two main channels and maneuvering basin in the harbor.

68. Initially, the study considered alteration of both the Slades Ferry and Brightman Street bridges. The Department of Public Works, Commonwealth of Massachusetts, was requested to furnish estimates of altering both bridges to provide for wider drawspans. As an alternative, a pipeline plan was studied. The pipeline would obviate the necessity for altering the bridges and provide the same benefits for existing and prospective shipping. The Public Works representatives furnished the estimates but declared that future planning would explore the possibility of eliminating the Slades Ferry Bridge upon the completion of the new high level bridge, the Braga Bridge. This bridge was completed in 1966 and the State has now indicated that the Slades Ferry

Bridge will be demolished and removed. Thus only the Brightman Street would require alteration. As alteration of this bridge was found to be more economical than the pipeline alternative, such alteration was included in the proposed plan of improvement.

CONCLUSIONS

69. The Division Engineer concludes that the existing 35-foot project in Fall River Harbor is inadequate not only for the vessels engaged in current coastwise petroleum and bituminous coal commerce but would preclude use of the larger vessels in future commerce. He believes that the existing project should be modified to correct this inadequacy. The proper modification consists of deepening the Mt. Hope Bay channel to 40 feet from deep water in Mt. Hope Bay to the existing turning basin at the head of the existing 35-foot channel, deepening the basin itself to 40 feet, and altering the drawspan of the Brightman Street Bridge to provide a clear channel width of 300 feet. He further considers that the Tiverton channel should be deepened to 40 feet for a channel width of 400 feet throughout, with widening at the bend leading toward Gulf Oil Wharf. The modification can be accomplished at an estimated Federal cost of $8, 762, 000 plus local costs of $497, 000 for bridge alteration. The comparison of annual benefits to annual charges results in a benefit-cost ratio of 3. 9 which indicates decisive economic justification of the project. Since the benefits are general in nature, local cooperation in the form of a cash contribution for channel deepening should not be required.

RECOMMENDATION

70. The Division Engineer recommends that the existing project for Fall River Harbor be modified to provide for:

a. Deepening the existing 400-foot wide by 35-foot deep Mt. Hope Bay channel to 40 feet within existing channel limits, from deep water in Mt. Hope Bay to and including the existing turning basin.

b. Deepening the existing 400-foot wide, 35-foot Tiverton channel to 40 feet to the vicinity of the Tiverton shore thence upstream to the vicinity of the Gulf Oil terminal, and widening the bend leading into this upper channel to 600 feet.

c. A channel 400 feet wide and 40 feet deep in Tiverton Lower Pool along the Tiverton waterfront to the vicinity of the Rhode Island Refining Corporation.

d. Altering the Brightman Street Bridge to provide for a clear channel width of 300 feet through the drawspan.

The modification is recommended subject to the conditions that local interests, as requirements of local cooperation:

a. Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and maintenance of the project.

b. Hold and save the United States free from damages due to construction of the project.

c. Make such alterations to underwater utilities or other obstructive features necessary to enable full realization of the project benefits.

d. Improve berths and access channels to a depth commensurate with project depth.

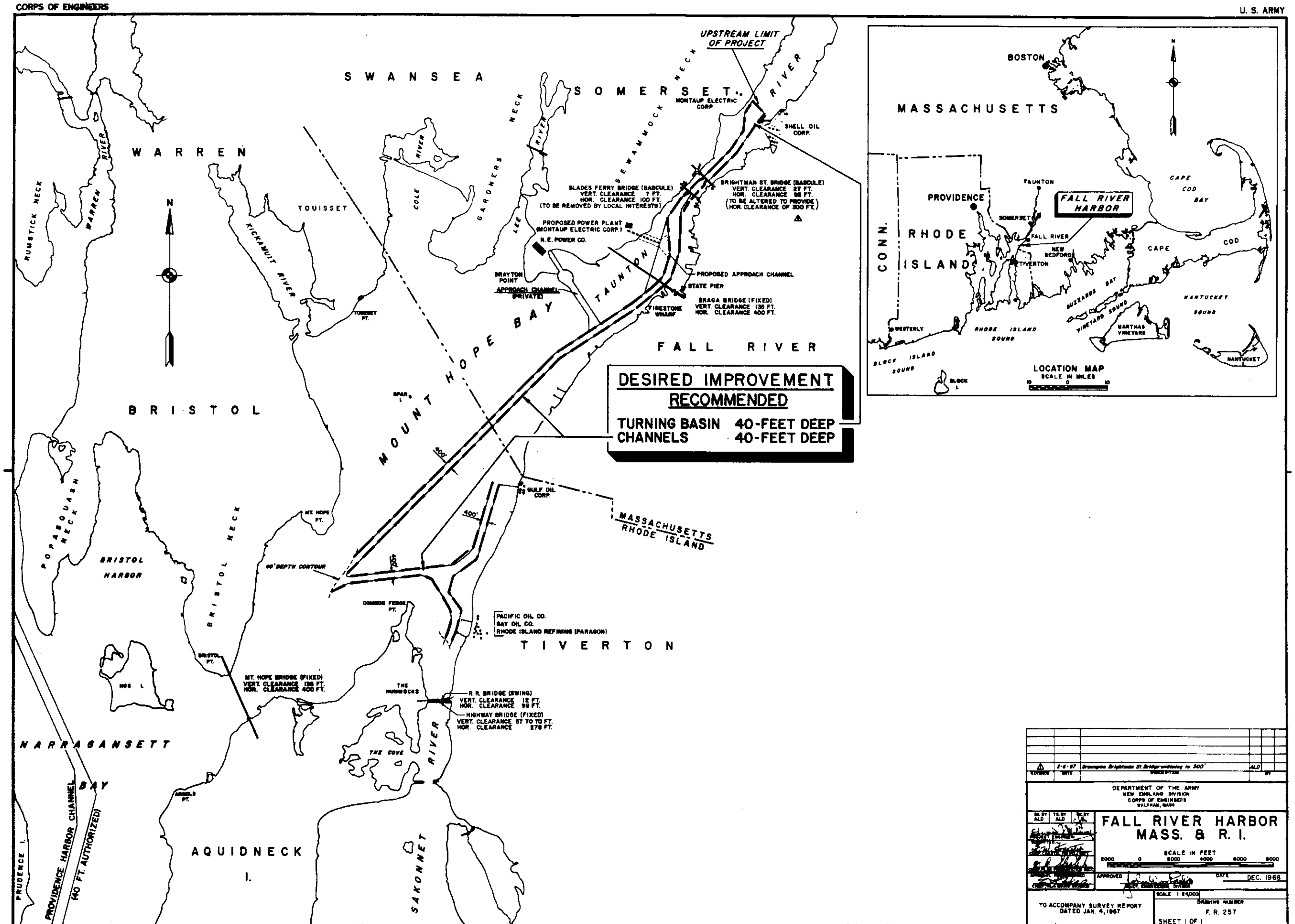
e. Assume construction costs in accordance with the principles of the Truman-Hobbs Act for altering the Brightman Street Bridge, said local share presently estimated at $497, 000, the remaining costs of $3, 178, 000 to be borne by the United States, and

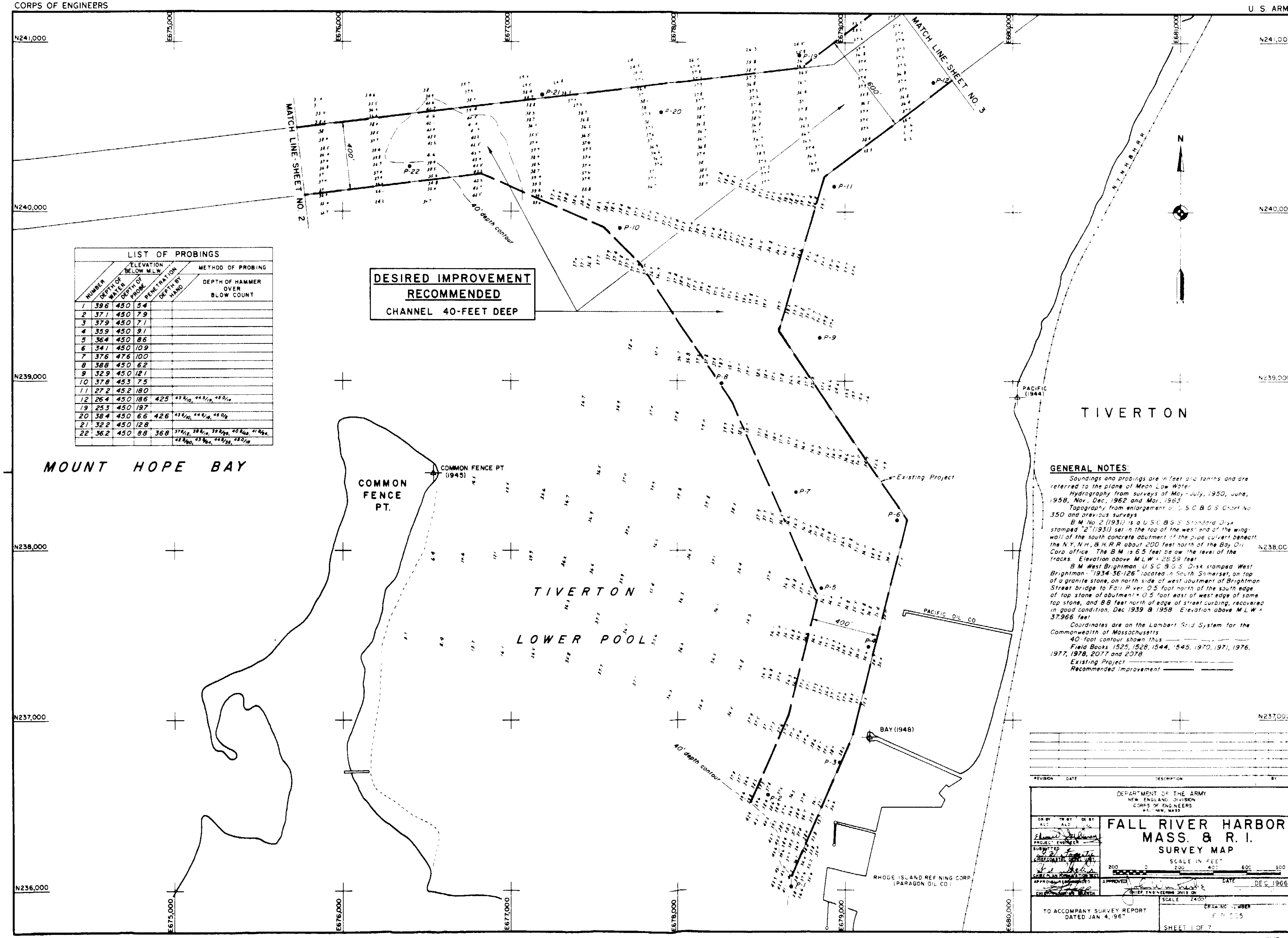
f. Demolish and remove the Slades Ferry Bridge at local expense.

The recommended project modification is also subject to a restriction that the Federal channels and basins will be at least 125 feet from the pierhead and bulkhead lines, to permit adequate berthing area without encroachment within Federal project limits.

The Federal first cost is estimated at $8, 762, 000 and the cost to local interests is estimated at $497, 000 for a total project cost of $9, 259, 000.

REMI O. RENIER
Colonel, Corps of Engineers
Acting Division Engineer


UPSTREAM LIMIT OF PROJECT
SWANSEA
SOMERSET
MONTAUP ELECTRIC CORP.
SHELL OIL CORP.
TAUNTON RIVER
WARREN
TOUISSET
KICKAMUIT RIVER
COLE RIVER
GARDNERS NECK
LEE RIVER
SEWAMMOCK NECK
RUMSTICK NECK
WARREN RIVER
SLADES FERRY BRIDGE (BASCULE)
VERT. CLEARANCE 7 FT.
HOR. CLEARANCE 100 FT.
(TO BE REMOVED BY LOCAL INTERESTS)
BRIGHTMAN ST. BRIDGE (BASCULE)
VERT. CLEARANCE 27 FT.
HOR. CLEARANCE 98 FT.
(TO BE ALTERED TO PROVIDE HOR. CLEARANCE OF 300 FT.)
PROPOSED POWER PLANT (MONTAUP ELECTRIC CORP.)
N. E. POWER CO.
BRAYTON POINT
APPROACH CHANNEL (PRIVATE)
PROPOSED APPROACH CHANNEL
STATE PIER
FIRESTONE WHARF
BRAGA BRIDGE (FIXED)
VERT. CLEARANCE 135 FT.
HOR. CLEARANCE 400 FT.
FALL RIVER
MOUNT HOPE BAY
BRISTOL
DESIRED IMPROVEMENT RECOMMENDED
TURNING BASIN 40-FEET DEEP
CHANNELS 40-FEET DEEP
400'
GULF OIL CORP.
MASSACHUSETTS
RHODE ISLAND
POPPASQUASH NECK
BRISTOL HARBOR
BRISTOL NECK
MT. HOPE PT.
40' DEPTH CONTOUR
COMMON FENCE PT.
PACIFIC OIL CO.
BAY OIL CO.
RHODE ISLAND REFINING (PARAGON)
TIVERTON
BRISTOL PT.
MT. HOPE BRIDGE (FIXED)
VERT. CLEARANCE 135 FT.
HOR. CLEARANCE 400 FT.
THE HUMMOCKS
R. R. BRIDGE (SWING)
VERT. CLEARANCE 12 FT.
HOR. CLEARANCE 99 FT.
HIGHWAY BRIDGE (FIXED)
VERT. CLEARANCE 57 TO 70 FT.
HOR. CLEARANCE 278 FT.
THE COVE
RIVER
NARRAGANSETT BAY
ARNOLD PT.
AQUIDNECK I.
SAKONNET
PRUDENCE I.
PROVIDENCE HARBOR CHANNEL (40 FT. AUTHORIZED)
BOSTON
MASSACHUSETTS
PROVIDENCE
TAUNTON
SOMERSET
FALL RIVER
NEW BEDFORD
TIVERTON
FALL RIVER HARBOR
CONN.
RHODE ISLAND
CAPE COD BAY
CAPE COD
BUZZARDS BAY
VINEYARD SOUND
MARTHAS VINEYARD
NANTUCKET SOUND
NANTUCKET
WESTERLY
RHODE ISLAND SOUND
BLOCK ISLAND SOUND
BLOCK I.
LOCATION MAP
SCALE IN MILES
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
FALL RIVER HARBOR
MASS. & R. I.
SCALE IN FEET
2000 0 2000 4000 6000 8000
DEC. 1966
SCALE 1:24,000
TO ACCOMPANY SURVEY REPORT DATED JAN. 4, 1967
F. R. 257
SHEET 1 OF 1



LIST OF PROBINGS					
	ELEVATION BELOW M.L.W.				METHOD OF PROBING
NUMBER	DEPTH OF WATER	DEPTH OF PROBE	PENETRATION	DEPTH BY HAND	DEPTH OF HAMMER OVER BLOW COUNT
1	39.6	45.0	5.4		
2	37.1	45.0	7.9		
3	37.9	45.0	7.1		
4	35.9	45.0	9.1		
5	36.4	45.0	8.6		
6	34.1	45.0	10.9		
7	37.6	47.6	10.0		
8	38.8	45.0	6.2		
9	32.9	45.0	12.1		
10	37.8	45.3	7.5		
11	27.2	45.2	18.0		
12	26.4	45.0	18.6	42.5	43.5/10, 44.5/19, 45.0/14
19	25.3	45.0	19.7		
20	38.4	45.0	6.6	42.6	43.6/10, 44.6/16, 45.0/8
21	32.2	45.0	12.8		
22	36.2	45.0	8.8	36.8	37.8/12, 38.8/16, 39.8/29, 40.8/48, 41.8/54,
					42.8/80, 43.8/84, 44.8/38, 45.0/18

GENERAL NOTES:

Soundings and probings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from surveys of May-July, 1950, June, 1958, Nov., Dec., 1962 and Mar., 1963.

Topography from enlargement of U.S.C.&G.S. Chart No 350 and previous surveys.

B.M. No 2 (1931) is a U.S.C.&G.S. Standard Disk stamped "2" (1931) set in the top of the west end of the wing-wall of the south concrete abutment of the pipe culvert beneath the N.Y., N.H., & H.R.R. about 200 feet north of the Bay Oil Corp office. The B.M. is 6.5 feet below the level of the tracks. Elevation above M.L.W. = 28.59 feet.

B.M. West Brightman U.S.C.&G.S. Disk stamped West Brightman-"1934-36-126" located in South Somerset, on top of a granite stone, on north side of west abutment of Brightman Street bridge to Fall River, 0.5 foot north of the south edge of top stone of abutment = 0.5 foot east of west edge of same top stone, and 8.8 feet north of edge of street curbing, recovered in good condition, Dec 1939 & 1958. Elevation above M.L.W. = 37.966 feet.

Coordinates are on the Lambert Grid System for the Commonwealth of Massachusetts.

40-foot contour shown thus

Field Books 1525, 1528, 1544, 1545, 1970, 1971, 1976, 1977, 1978, 2077 and 2078.

Existing Project

Recommended Improvement

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR BY ALT — TR BY ALD — CK BY

PROJECT ENGINEER

SUBMITTED — CHIEF COASTAL DESIGN UNIT

CHIEF PLAN FORMULATION SECT

APPROVAL RECOMMENDED — CHIEF PLANNING BRANCH

FALL RIVER HARBOR MASS. & R. I.

SURVEY MAP

SCALE IN FEET: 200 0 200 400 600 800

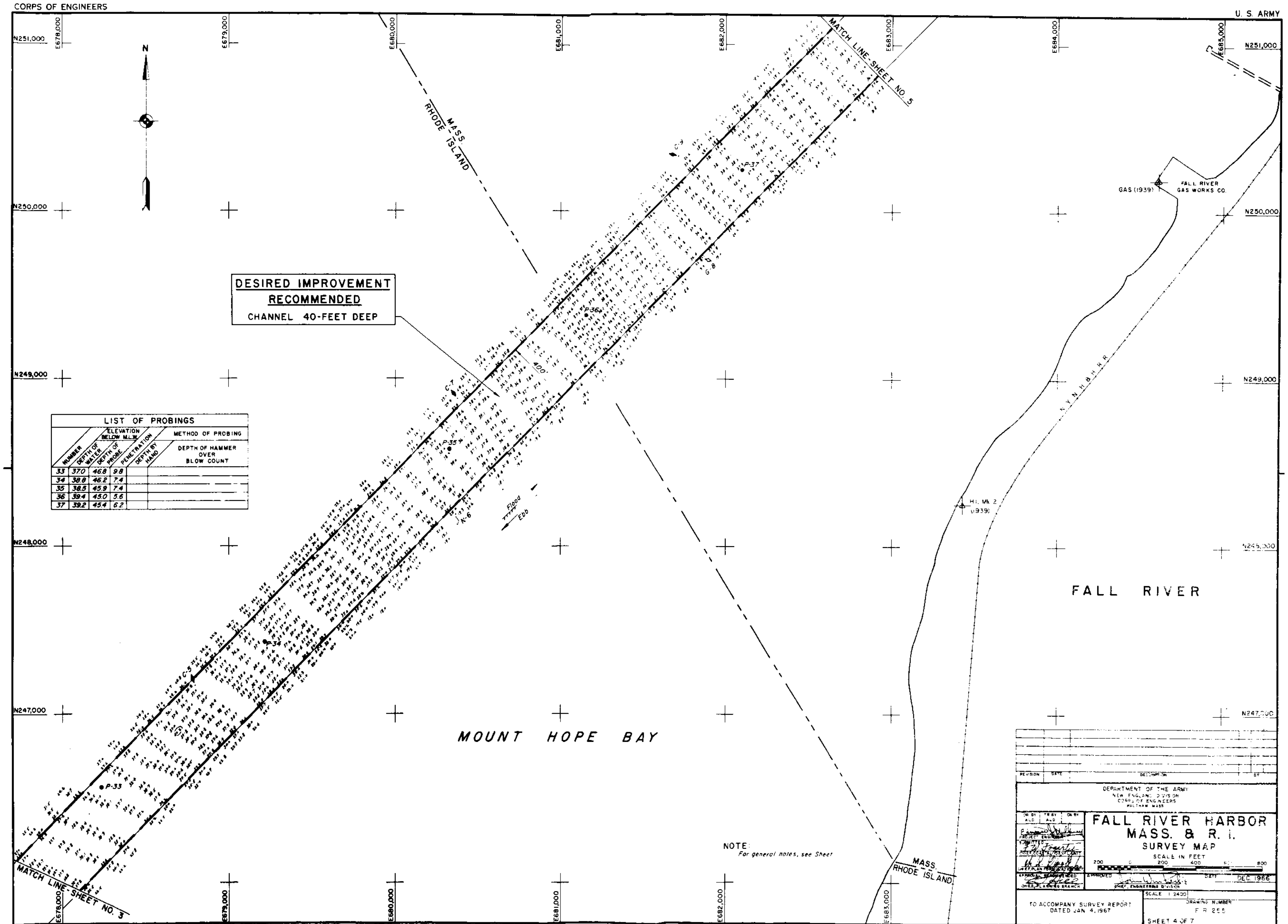
APPROVED — CHIEF, ENGINEERING DIVISION — DATE DEC 1966

TO ACCOMPANY SURVEY REPORT DATED JAN 4, 1967

SCALE 1" = 2400'

DRAWING NUMBER

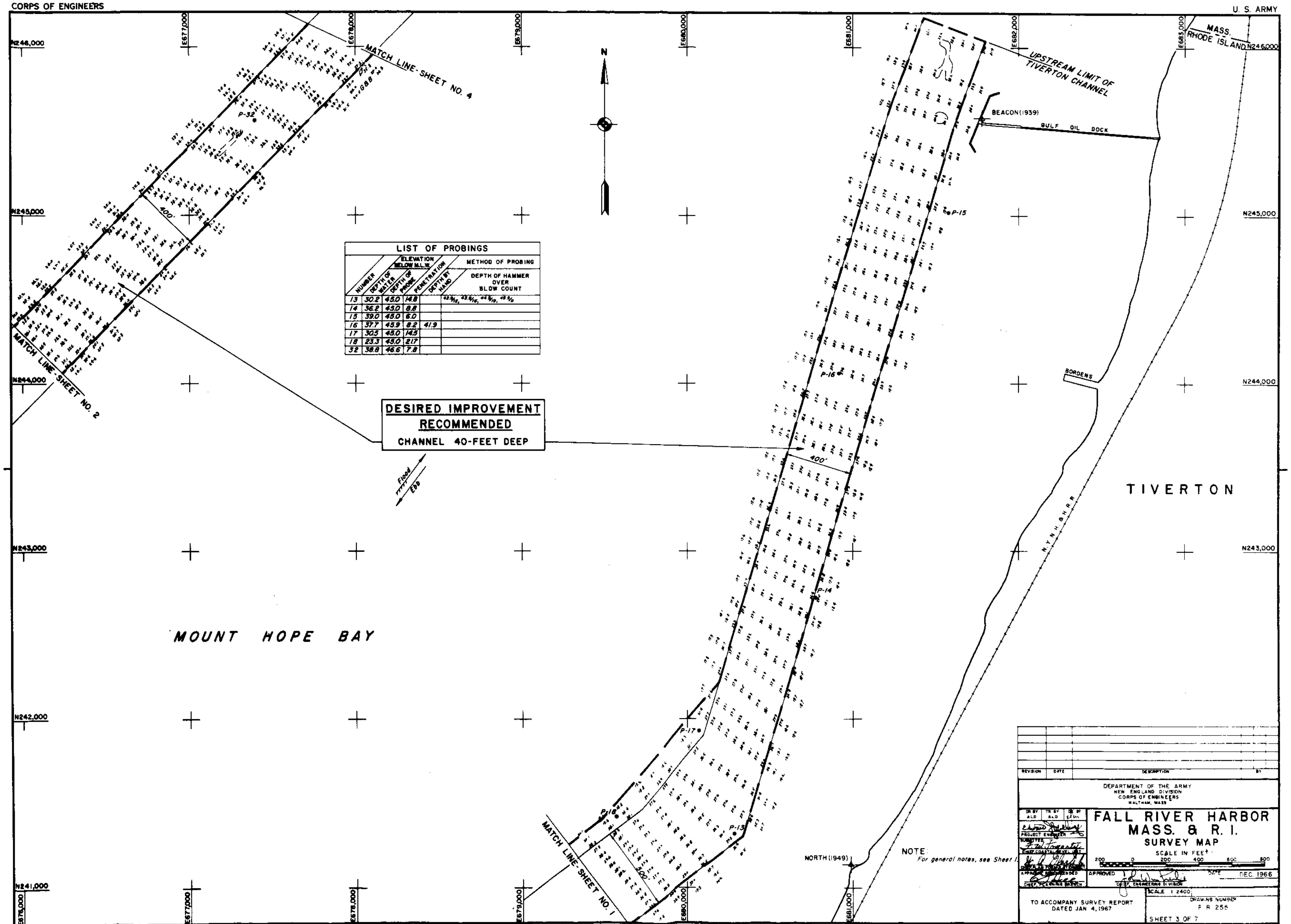
SHEET 1 OF 7



LIST OF PROBINGS

Number	Elevation below M.L.W.: Depth of Water	Depth of Probe	Penetration	Depth by Hand	Method of Probing: Depth of Hammer over Blow Count
33	37.0	46.8	9.8		
34	38.8	46.2	7.4		
35	38.5	45.9	7.4		
36	39.4	45.0	5.6		
37	39.2	45.4	6.2		

CORPS OF ENGINEERS U. S. ARMY



LIST OF PROBINGS

Number	Elevation below M.L.W.: Depth of water	Elevation below M.L.W.: Depth of probe	Penetration	Depth by hand	Method of probing: Depth of hammer over blow count
13	30.2	45.0	14.8		42.9/12, 43.9/16, 44.9/19, 45.9/9
14	36.2	45.0	8.8		
15	39.0	45.0	6.0		
16	37.7	45.9	8.2	41.9	
17	30.5	45.0	14.5		
18	23.3	45.0	21.7		
32	38.8	46.6	7.8		

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

FALL RIVER HARBOR
MASS. & R. I.
SURVEY MAP

SCALE IN FEET
200 0 200 400 600 800

DR BY ALD | TR BY ALD | CK BY

PROJECT ENGINEER
SUBMITTED
CHIEF, COASTAL DEVEL. UNIT
CHIEF, PLAN FORMULATION SECT.
APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH
APPROVED
CHIEF, ENGINEERING DIVISION
DATE DEC. 1966

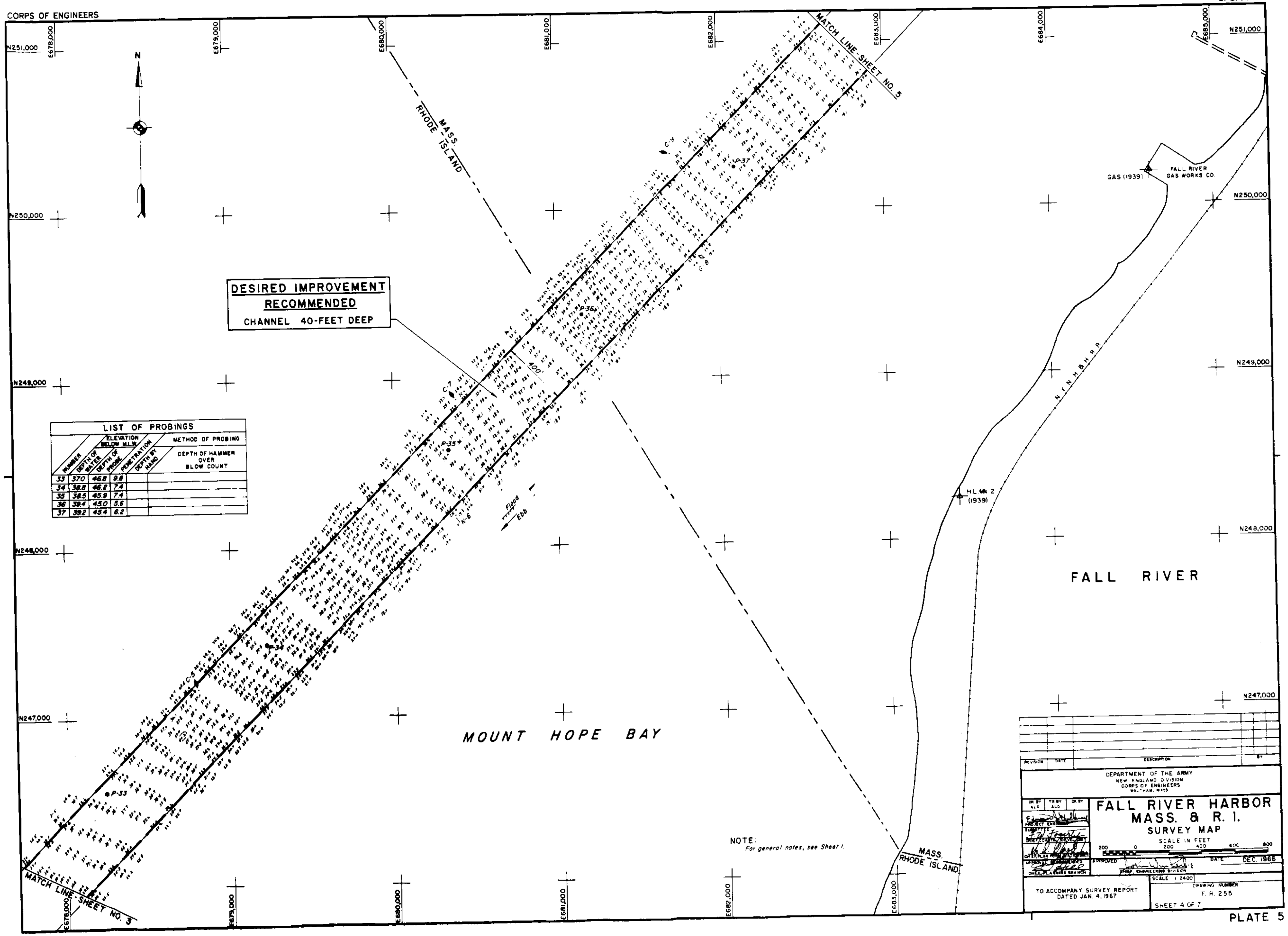
SCALE 1:2400

TO ACCOMPANY SURVEY REPORT
DATED JAN 4, 1967

DRAWING NUMBER
F R 255

SHEET 3 OF 7

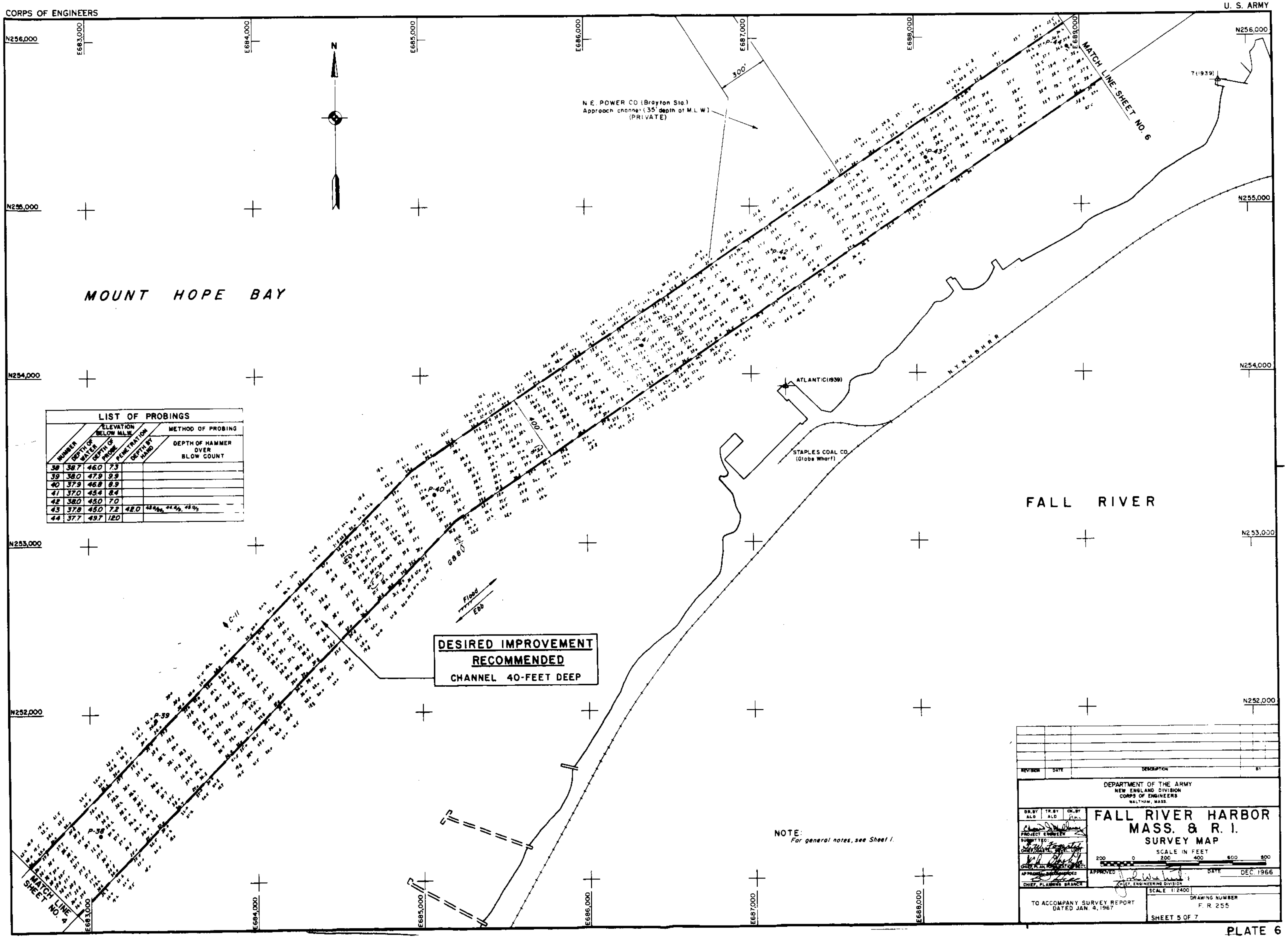
PLATE 4



LIST OF PROBINGS

Number	Elevation below M.L.W. – Depth of water	Elevation below M.L.W. – Depth of probe	Penetration	Depth by hand	Method of probing – Depth of hammer over blow count
33	37.0	46.8	9.8		
34	38.8	46.2	7.4		
35	38.5	45.9	7.4		
36	39.4	45.0	5.6		
37	39.2	45.4	6.2		

PLATE 5



LIST OF PROBINGS

NUMBER	ELEVATION BELOW M.L.W. — DEPTH OF WATER	ELEVATION BELOW M.L.W. — DEPTH OF PROBE	PENETRATION	METHOD OF PROBING — DEPTH BY HAND	METHOD OF PROBING — DEPTH OF HAMMER OVER BLOW COUNT
38	38.7	46.0	7.3		
39	38.0	47.9	9.9		
40	37.9	46.8	8.9		
41	37.0	45.4	8.4		
42	38.0	45.0	7.0		
43	37.8	45.0	7.2	42.0	42.0/20, 44.4/5, 45.0/3
44	37.7	49.7	12.0		

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY ALD | TR. BY ALD | CK. BY

PROJECT ENGINEER

SUBMITTED:
CHIEF, COASTAL SURVEY UNIT

CHIEF, PLAN FORMULATION SECT.

APPROVAL RECOMMENDED:
CHIEF, PLANNING BRANCH

FALL RIVER HARBOR
MASS. & R. I.
SURVEY MAP

SCALE IN FEET
200 0 200 400 600 800

APPROVED
CHIEF, ENGINEERING DIVISION

DATE DEC. 1966

SCALE 1:2400

TO ACCOMPANY SURVEY REPORT DATED JAN. 4, 1967

DRAWING NUMBER
F. R. 255

SHEET 5 OF 7

CORPS OF ENGINEERS U. S. ARMY

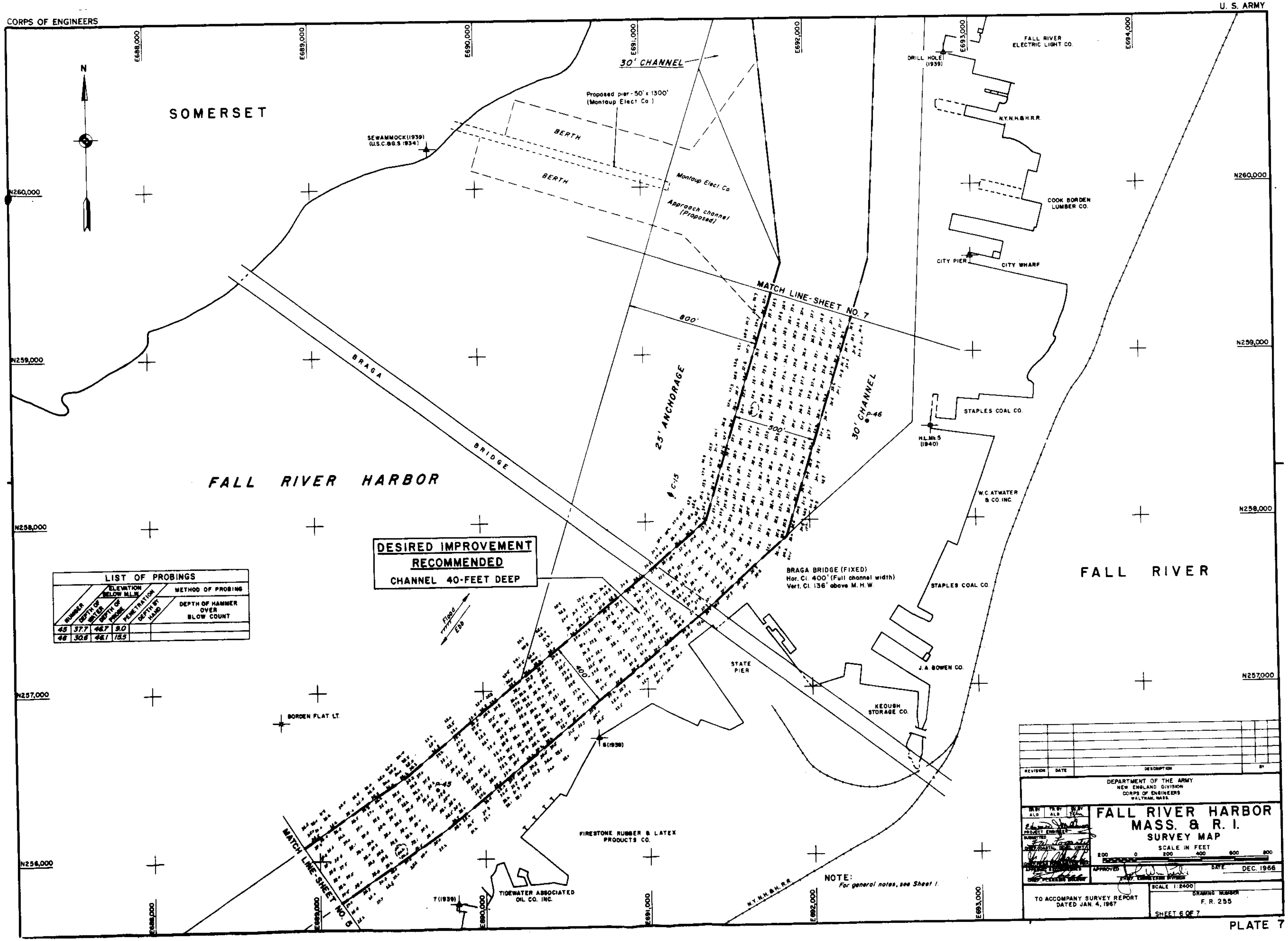
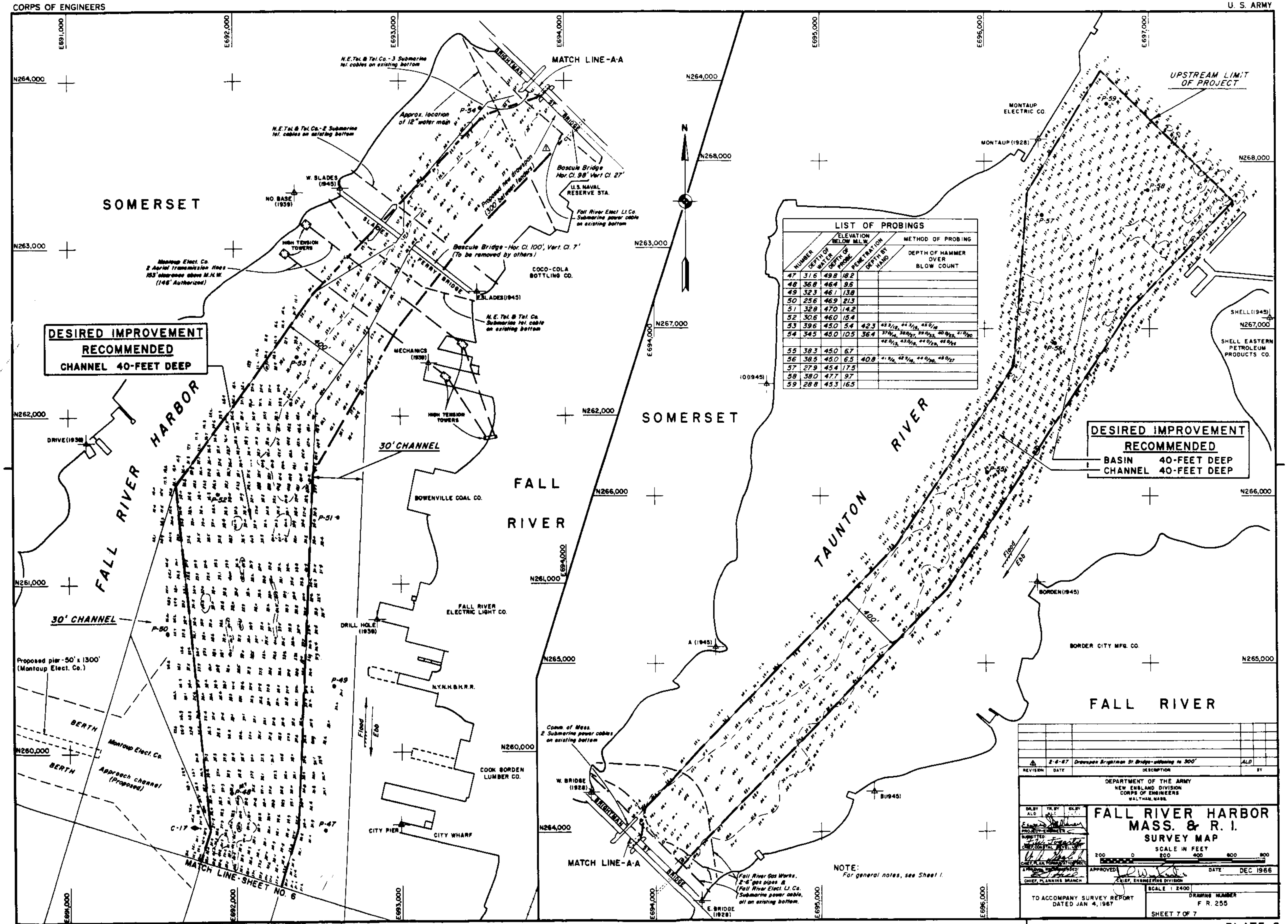


PLATE 7



LIST OF PROBINGS					
NUMBER	ELEVATION BELOW M.L.W. DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	METHOD OF PROBING DEPTH BY HAND	METHOD OF PROBING DEPTH OF HAMMER OVER BLOW COUNT
47	31.6	49.8	18.2		
48	36.8	46.4	9.6		
49	32.3	46.1	13.8		
50	25.6	46.9	21.3		
51	32.8	47.0	14.2		
52	30.6	46.0	15.4		
53	39.6	45.0	5.4	42.3	43.3/12, 44.3/16, 45.0/18
54	34.5	45.0	10.5	36.4	37.0/14, 38.0/27, 39.0/35, 40.0/25, 41.0/20
					42.0/13, 43.0/19, 44.0/29, 45.0/26
55	38.3	45.0	6.7		
56	38.5	45.0	6.5	40.8	41.9/4, 42.9/16, 44.0/36, 45.0/27
57	27.9	45.4	17.5		
58	38.0	47.7	9.7		
59	28.8	45.3	16.5		

REVISION	DATE	DESCRIPTION	BY
△	2-6-67	Drawspan Brightman St. Bridge - widening to 300'	ALD

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

FALL RIVER HARBOR
MASS. & R. I.
SURVEY MAP

SCALE IN FEET: 200 0 200 400 600 800

DR. BY ALD TR. BY ALL CK. BY

PROJECT ENGINEER

SUBMITTED: CHIEF, COASTAL LEVEL UNIT

CHIEF, PLAN FORMULATION SECT.

APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION

DATE DEC 1966

SCALE 1:2400

TO ACCOMPANY SURVEY REPORT DATED JAN 4, 1967

DRAWING NUMBER F. R. 255

SHEET 7 OF 7

FALL RIVER HARBOR

MASSACHUSETTS AND RHODE ISLAND

APPENDIX A

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

1. General. This appendix presents estimates of first costs, both Federal and non-Federal, and annual charges for the improvement of Fall River Harbor, as described in the section of the report titled, "Plan of Improvement." The plan includes deepening the Tiverton channel to 40 feet, widening it at the bend leading north to Gulf Wharf, and providing a 40-foot deep channel 400 feet wide on the south leg of this channel to the vicinity of the Rhode Island Refining Corporation Wharf. The plan also includes deepening the Bay channel to 40 feet within existing project limits to the existing 850' x 1100' maneuvering basin and deepening the basin itself to 40 feet. Estimates are also included for drawspan alteration of the Brightman Street Bridge. Present planning by the Commonwealth of Massachusetts includes abandonment and demolition of the Slades Ferry Bridge. Should navigation improvement be authorized, the existing Brightman Street Bridge would be unduly restrictive to navigation. The State has been notified of this condition and has stated that in such case it will erect a new bridge with a drawspan of adequate width. This appendix contains an estimate of the cheaper alternative of providing an adequate drawspan by alteration of the existing bridge, with costs apportioned according to provisions of the Truman-Hobbs Act. Estimates for all features of the project have been computed separately, and also combined into a single project. Alternative plans have been considered and their costs are presented in this appendix.

2. Cost Estimates. Details of first costs in this appendix include estimates of dredging costs, contingencies, engineering, overhead, and supervision and administration for the 40- and 45-foot depths requested by local interests, and for alternative considered plans for 37- and 38-foot channels. Local costs include bridge costs to be incurred by alteration of the existing Brightman Street Bridge. Pipeline costs were also estimated for the alternative plan of improvement.

3. Materials. Past experience in dredging indicates the presence of mud, gravel and sand. A sizable boulder area exists near the Tiverton wharves, and hard mixtures of material lie between the bridges in Fall River. Probings taken during the study indicate no change in the character of the materials in dredging to either the 40- or 45-foot depths.

4. Unit Price. Unit Prices are based on recent experience in similar dredging in the area. The U. S. Coast Guard has advised that no additional navigational aids would be necessary in the event of improvement.

5. Interest Rate. An interest rate of 3.125 percent for both Federal and non-Federal investments was used. This rate provides for a factor of .00854 for amortization over a 50-year period.

6. Maintenance. Estimated additional maintenance is based on experienced maintenance in the existing project, adjusted to allow for the areas contained within the proposed project limits.

7. Overdepth and Side Slopes. Estimated dredging quantities allow for 2 feet overdepth both in the channels and basin. Side slopes provide for 1-foot vertical on 3-foot horizontal in all cases.

8. Pre-Authorization and Study Costs. The sum of $35,000 has been expended for survey and study costs.

9. Berth Improvement Costs. Berth improvements have not been included in the estimated non-Federal first cost of improvement. Although berth improvements that will be made to enable full use of the improved channel are estimated to cost $850,000, these costs are paid by the terminal owner and must be recovered in charges which are included in the final selling price of the product, or the terminal would operate at a loss and could not continue in business. Therefore, these costs are self-liquidating and not chargeable to overall first cost of the project. The terminal operators must make berth improvements to remain competitive. Reasonable assurances of berth improvements, in the event of improvement, have been received.

10. Disposal Areas. The areas immediately adjoining the waterway are, for the most part, of a generally developed metropolitan character with no adjacent spoil disposal areas available. Experience in past dredging, both in the 35-foot project and in maintenance, has borne out this fact, as it became increasingly impracticable to secure suitable land spoil areas. It is considered therefore that material will be removed by bucket dredge and spoiled at sea in suitable deep water areas.

PROJECT COST ESTIMATES

Mt. Hope Bay

(40' Channel)

Federal

Cost Account Number		Cost Estimate (November 1966)
09	Channels	
	Channel and Basin 40 feet deep 2,608,000 c. y. of mud, sand and gravel @ $1.15.	$2,999,200
	Contingencies (15%)	449,800
		$3,449,000
30	Engineering and Design	120,000
31	Supervision and Administration	141,000
	Total Mt. Hope Bay Channel(1)	$3,710,000

(1)Exclusive of bridge alteration costs.

Tiverton

Cost Account Number		Cost Estimate (November 1966)
09	Channels	
	Channel, 40 feet deep 1,395,000 cubic yards of mud, sand, and gravel at $1.15.	$1,495,000
	Contingencies (15%)	224,000
		$1,719,000
30	Engineering and Design	60,000
31	Supervision and Administration	95,000
	Total Tiverton Channel	$1,874,000
	*Bridge Alteration	3,178,000
	Total Federal Cost	$8,762,000
	Non-Federal (Bridge Alteration)	497,000
	Total Project Cost	$9,259,000

*Includes $75,000 for Supervision and Administration by Corps of Engineers.

ESTIMATES OF ANNUAL CHARGES

50-Year Project Life

40-Foot Mt. Hope Bay Channel

Federal First Cost (dredging)		$3,710,000
Federal Annual Charges		
Interest and Amortization ($3,710,000 x 0.03979)	$147,600	
Additional Annual Maintenance	19,400	
		$ 167,000
Federal First Cost (Bridge Alteration) $3,178,000		
Federal Annual Charges		
Interest and Amortization ($3,178,000 x 0.03979)		$ 126,500
Non-Federal Annual Charges		
Bridge Alteration ($497,000 x 0.03979)		$ 19,700

40-Foot Tiverton Channel

Federal First Cost (dredging) $1,874,000		
Interest and Amortization ($1,874,000 x 0.03979)	$ 74,600	
Additional Annual Maintenance	4,400	
		$ 79,000
Total Annual Charges (Federal and Non-Federal		$ 392,200

Benefit/Cost Ratio - 40-foot Recommended Project

	Benefits	Costs	Ratio
Bay Channel (Deepening)	$ 344,500	$167,000	2.1
Tiverton Channel	95,000	79,000	1.2
Bridge Alteration	1,083,000	146,200	7.4
Combined Project	$1,522,500	$392,200	3.9

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COMPARISON OF BENEFIT/COST RATIOS

Channels of Various Depths

	37-Foot Channel	38-Foot Channel	45-Foot Channel
BAY CHANNEL (Deepening)			
Benefits	$187,000	$225,000	$356,000
Costs	129,000	137,000	360,000
Ratio	1.4	1.6	1.0
TIVERTON CHANNEL			
Benefits	$ 51,000	$ 60,000	$ 99,000
Costs	39,000	50,000	190,000
Ratio	1.3	1.2	0.5
COMBINED PROJECT (Excl. Bridge Alteration)			
Benefits	$238,000	$285,000	$455,000
Costs	168,000	227,000	550,000
Ratio	1.4	1.3	0.8

FALL RIVER - UPPER HARBOR
(Estimate of Pipeline Alternative)

Terminal Cost (Montaup)

Berth (850 x 200 x 40')

Av Cut = 24'

850 x 200 = 170,000 x 24 = 4,080,000 cu. ft.

$\frac{4,080,000}{27}$ = 150,000 c. y.

Approach Channel

Av Cut = 16'

$\frac{300 \times 300 \times 16}{27} = \frac{90,000 \times 16}{27} = \frac{1,440,000}{27}$ = 204,800 c. y.

Total - Dredging 354,000 c. y. of mud, sand & gravel @ $1.15 =		$ 407,000
Mooring Dolphins		
Circular - 20' Circum = 62.83		
Piles 1.5' wide = 41 piles		
Length Pile (Av) 75' Area 75 x 1.5 = 112.5 sq. ft.		
112.5 x 41 = 4612.5 sq. ft.		
Weight (32# sq. ft.) 4612.5 x 32 = 148,000 = 74 tons		
74 tons @ $175/ton	$ 13,000	
Driving $150/ton	11,000	
Tie rods, walers, hardware, etc. 9000# @ $1.00	9,000	
Backfill 350 c. y. gravel @ $3.00	1,000	
Concrete 40 c. y. @ $25	1,000	
	$ 35,000	
3 Needed - Say		$ 100,000
Pumping Station & Steam Generator		
Building (Incl. Generator)	$ 50,000	
Pumps - 2 (1 working - 1 standby)	50,000	$ 100,000
Pipeline		
1 Steam tracered pipeline 10,000' @ $60/ft		$ 600,000
Tanks		
2 - 150,000 bbl @ $75,000	$150,000	
1 - 50,000 bbl @ $50,000	50,000	$ 200,000
Sub-total		$1,407,000
Contingencies		162,000
		$1,569,000
Engineering & Design		120,000
Supervision & Administration		121,000
		$1,810,000
Rights of Way	$ 60,000	
Site (purchase)	30,000	90,000
TOTAL		$1,900,000

Terminal Cost (Shell)

Berth (850' x 150' x 40')	
Av Cut 10'	
$\frac{850 \times 150 \times 10}{27} = \frac{1,275,000}{27} = 47,000$ c. y.	
Approach Channel	
110, 000 sq. ft. x 10 = $\frac{1,110,000}{27}$ = 41, 000 c. y.	
41, 000 + 47, 000 = 88, 000 c. y. dredging	
88, 000 c. y. of mud, sand & Gravel	
@ $1. 15 = $[illegible]01, 000 (say $100, 000)	$100, 000
Terminal	
3 caisson type mooring dolphins	
@ $35, 000 = $105, 000 (say $100, 000)	$100, 000
Catwalk trestle pipe support	10, 000
Pumping Station and Generator	
Building (Incl. Generator)	100, 000
5 Pumps (4 working - 1 standby) @ $20, 000	100, 000
Pipelines	
3 - 10'' clean lines @ $18/ft.	
6500 x 18 =	$117, 000
1 Steam traced pipeline @ $60/ft.	
6500 x 60 =	$390, 000
Land acquisition & rights-of-way	$100, 000
Total	$1, 017, 000
Contingencies	153, 000
	$1, 170, 000
Engineering and Design	60, 000
Supervision & Administration	70, 000
Total Cost (Shell)	$1, 300, 000
Cost to Montaup	1, 900, 000
Total Cost Pipe[illegible] Alternative	$3, 200, 000

Annual Charges Pipeline (Lo[illegible]) (25 yr. life)

Interest and Amortization (3. [illegible]%)	
$3, 200, 000 x 0. 05823	$ 186, 300
Annual Maintenance	32, 700
	$ 219, 000

Comparison of Benefits to Costs

$$\frac{\text{Annual Benefits}}{\text{Annual Costs}} \quad \frac{\$1,083,000}{\$\ 160,000} = 6.8$$

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BRIGHTMAN STREET BRIDGE ALTERATION

ESTIMATE OF COSTS

(TRUMAN-HOBBS ACT)

1.	Original cost of bridge	$ 550,000
2.	Year of Completion - 1914.	
3.	Overall anticipated life - 75 years	
4.	Consider bridge alteration to be completed in 1970. Thus bridge will have completed 56/75 of its anticipated life. 56/75 = 0.7467.	
	Construction costs of new drawspan - (Mass. DPW)	3,600,000 $~~2,300,000~~ (incl contingencies) (1)
	Costs of Removal (entire bridge) = (Mass. DPW)	$ 570,000
	Removal of Drawspan & Channel Piers (60% removal of entire bridge) =	$ 342,000
	Costs to bridge owner (Commonwealth of Massachusetts)	
	Removal of drawspan $342,000 x 0.7467 = $255,371 Present worth 19 yrs @ 3.125% $255,371 x 0.5747 = $146,761	$ 146,800
	Contribution by bridge owner Original cost of drawspan (60% of $550,000) = $330,000 $330,000 x 0.7467 =	$ 246,400

(1) Excluding Government costs $75,000 Supervision, Administering Payments under Truman-Hobbs Act.

APPORTIONMENT OF COSTS (TRUMAN-HOBBS)
BRIGHTMAN ST. BRIDGE

		United States	Commonwealth of Massachusetts
A.	Removal of old drawspan	$ 195, 200	$146, 800
B.	Contribution because of expired life of old drawspan (56/75 of old drawspan)		246, 400
C.	Contribution because of unexpired life of old drawspan (19/75 of capital cost of old drawspan)	83, 600	
D.	All other costs for construction of new drawspan, exclusive of contingencies, engineering and design	2, 173, 800	
	Subtotal (Federal share - 86. 2 percent)	$2, 452, 600	$393, 200
	Contingencies (Federal share 86. 2 percent)	368, 000	59, 000
	Engineering & Design, Inspection (Federal 86. 2 percent)	282, 400	44, 800
	Supervision and Administration	75, 000	
	TOTAL	$3, 178, 000	$497, 000

Total Cost of Alteration $3, 675, 000

Annual Charges Bridge Alteration

Federal Investment $3, 178, 000	
Interest and Amortization ($3, 178, 000 x 0. 03979)	$ 126, 500
Non-Federal Investment - $497, 000 ($497, 000 x 0. 03979)	$ 19, 700
Total Annual Charges	$ 146, 200

B/C Ratio of Alteration

$$\frac{\$1,083,000}{\$\ 146,200} = 7.4$$

APPENDIX B

ECONOMICS

1. General. - Fall River Harbor is a receiving port. Similar to other comparable harbors in the New England area, it is a prime transfer point for petroleum products bound to retail markets in the tributary area. An additional function of the harbor entails the delivery of fossil fuels to conventional electrical generating stations, which are located adjacent to the deep-draft channels. The delivery of the fuels is direct and eliminates the need for rehandling. Direct delivery in this manner reduces transportation costs of the fuels and provides for more economical power in the tributary area. The savings relate directly to power costs because fuel costs are included in determination of allowable power rates, as determined by State regulatory agencies. For this reason electric utility companies, wherever practicable, locate fossil fuel fired generating plants on sites which are readily accessible to deep-draft channels. Recent improvements in high voltage transmission with consequent smaller transmission line losses and the availability of unlimited cooling water will add to the desirability of locating future conventional power plants on tidewater.

2. At the present time there are two 35-foot deep channels in this harbor. Both of these channels originate in deep water in Mount Hope Bay. One, known locally as the "Bay Channel", serves the upper part of the harbor, which is located in the municipalities of Somerset and Fall River, Massachusetts. Deep-draft commerce to this area consists chiefly of petroleum products to Fall River plus bituminous coal and residual fuel oil to the power plants in Somerset. The Tiverton Channel serves the waterfront oil terminals in Tiverton, Rhode Island. There are 4 major facilities in this area. One of these terminals serves as a distribution point for the United States Air Force. The other three are private commercial facilities. All of the facilities deal solely in petroleum products. Until recent years, the existing 35-foot channels were adequate for the harbor commerce. This situation has undergone a change. In the current coastwise trade in these products, bulk carriers, both colliers and tankers, have increased to such a size that the Fall River harbor channels are inadequate for navigation by the larger vessels. In some cases the larger vessels are subjected to tidal delays and denied navigation in others. Improvement of the channel will reduce or eliminate the navigation inadequacies, thereby producing more economical transportation of the commerce. The benefits for such transportation savings will depend upon the amount of commerce to be carried and the sizes of vessels expected to carry the commerce. The anticipated increase in future commerce will depend, in large part, on population increases in the same period.

3. Population. - The harbor's tributary area lies largely in Massachusetts and eastern Rhode Island. The Montaup Electric Company in its exhibits at the public hearing stated that it serves 520,000 customers in Rhode Island and Massachusetts. However, this is only a portion of the population served by this port. Over 700,000 tons of petroleum products are received at Fall River and transhipped via 6-inch pipelines to the cities of Waltham, and the town of Boylston, near Worcester, Massachusetts. Both of these municipalities lie outside of the power company's service area. An estimate of the tributary area served by the port indicates a population of 1,000,000. In 1960 the U.S. Bureau of Census estimated that the national population growth will average somewhat more than 2.0 percent annually for the next 50-year period. In a report ("Projective Economic Studies of New England) by Arthur D. Little, Inc., the population increase was projected at the rate of 1.5 percent annually to the year 1980, 2.0 percent to the year 2000 and 2.5 percent to the year 2020. For purposes of this report, and in the interests of conservatism, an average annual gain of 2 percent was used for population increase.

4. Petroleum Demand. - The American Petroleum Institute in its 1959 centennial edition of "Petroleum Facts and Figures", detailed the annual national increase in per capita demand of petroleum products. The 1949 demand increased from 14.2 barrels to 19.1 barrels in 1958, an increase of 34.5 percent in the 10-year period. The demand in this locality increased from 29 to 32 barrels for the 10-year period. Several authoritative forecasts of future demand have been made. The Department of the Interior, in its 1960 edition of "Mineral Facts and Figures", estimates the national demand to be 26.4 bbls per capita in 1975. The Joint Economic Committee Study in "Study Paper No. 13-6, December, 1959, The Adequacy of Resources for Economic Growth in the United States", estimates demand to be approximately 33 barrels per capita in the year 2000.

5. As shown in the previous paragraph, the per capita demand in this area is higher than the national average. The higher demand is considered to result from the almost universal use of light fuel oil for domestic heating purposes and from the use of residual oil for electrical generation and for heating of large buildings. The demand is expected to increase but at a slower rate than the national average. The demand for this locality is estimated conservatively to be 40 barrels per capita in the year 2022. This figure represents an increase of about 25 percent over the present demand. The increase in national per capita demand as forecast above would be about 73 percent. After this time, advancements in atomic and solar energy plus increased use of other fuels for domestic heating purposes will tend to stabilize the demand.

6. Commerce. - Fall River Harbor commerce for the latest ten year period has shown a fairly consistent average increase. In 1955 the total overall commerce amounted to 2,013,161. The 1964 commerce was 3,161,590

tons, a gain of about 57 percent over the 1955 total. The chief waterborne commodities were 1,800,509 tons of petroleum products which accounted for 57 percent of the total commerce. Bituminous coal accounted for 42 percent and the remaining 1 percent consisted of diversified items such as latex, building, cement, sulphuric acid and coal tar products. For the purpose of this report, only that portion of the commerce received in deep-draft oceangoing vessels will be considered in benefit evaluation for navigational improvement. In 1964 total petroleum receipts consisted of 1,426,835 tons of coastwise traffic and 373,674 tons of foreign imports. Of this petroleum commerce, 1,200,000 tons was received in deep-draft ships for general use, exclusive of the petroleum received at the power plants. In addition, about 1,339,471 tons of bituminous coal were received. A comparative statement of traffic for the most recent 10 year period is shown in the following tabulation.

TABLE NO. B-1

Fall River Harbor, Mass.

Year	Tons	Passengers
1955	2,013,161	18,136
1956	2,201,889	34
1957	2,101,120	-
1958	2,101,916	1,212
1959	2,174,230	-
1960(1)	2,942,012	-
1961	2,179,633	-
1962	2,599,329	-
1963	2,737,650	-
1964	3,161,590	-

(1) 1960 commerce shows an abnormal increase over 1959. The increase was temporary and resulted from barge shipments of about 770,000 tons of granite to Newport, R.I. for breakwater construction.

7. Future Commerce. - Commerce in this harbor is expected to increase materially in future years. In part, the increases will result from that part of the petroleum commerce which is now received at the oil terminals and distributed to retail markets. This facet of increase will depend on population growth and increased demand which will result from new and more varied use of petroleum products. The remaining portion of increase will result from expansion of conventional electrical power generating facilities in the locality. Each part of anticipated increase will be treated separately in the following paragraphs.

8. In 1961, commerce to an existing power plant (Montaup) included both fuels, bituminous coal, and oil. The plant has a rated capacity of 330,000 kilowatts and can convert readily to the use of either fuel. The

extent of use of either fuel is dependent on several factors, such as price, quotas, and availability. Prior to Federal import regulation of residual oil, this type of fuel was used to a great extent in electrical generation, as it provided for more economical operation. The use of oil in lieu of coal in New England had ranged from 65 to 98 percent in most power stations, located on the seacoast. Bituminous coal is now being used in greater proportion, particularly at new stations for which it has been difficult to obtain increased oil quotas. It is expected that present restrictions will be relaxed in the future. As no specific change in residual oil imports can be forecast, estimates of future commerce to the power companies will be predicated on the use of both fuels for equal amounts of electrical generation. Thus, for the existing 330,000 kw plant, either 534,000 tons of coal or 402,000 tons of residual oil would be needed annually if either were used exclusively. On this basis and assuming 50 percent generation for each fuel, future annual commerce to the existing plant was estimated as 267,000 tons of coal and 201,000 tons of oil. Table B-2 shows computations for annual average fuel consumption.

TABLE B-2

ESTIMATES OF FUEL CONSUMPTION OVER
PROJECT LIFE (POWER COMPANIES)

Load Factor, Power Area 2 (F.P.C. 1980) 57%
Av. Annual Heat Rate (F.P.C.) 9400
Av. Annual Av. Operating Time in Hours
365 x 24 x 0.57 = 4993 hours
B.T.U. requirements/kw/yr
4993 x 9400 = 46,934,000
Coal = 14,500 b.t.u./lb (heat content - West Virginia bituminous)

$$\frac{46,934,000}{14,500} = 3236\#/kw/yr = 1.618 \text{ tons/kw/yr}$$

Av. Annual Requirements - Coal
1.618 x 330,000 = 533,940 T, say 534,000
1.618 x 500,000 = 809,000 T, say 810,000
1.618 x 1,000,000 = 1,618,000 T, say 1,620,000
Av. Annual Requirements - Oil
Oil = 19,250 b.t.u./lb. (Heat Content) A.P.I.

$$\frac{46,934,000}{19,250} = 2438\#/kw/yr = 1.219 \text{ tons}$$

330,000 x 1.2185 = 402,270 T, say 402,000
500,000 x 1.2185 = 609,500 T, say 610,000
1,000,000 x 1.2185 = 1,219,000 T, say 1,220,000

9. Future commerce will be augmented by the recent construction of one new power plant and future construction of a second one in the Fall River area. The first, constructed by the New England Power Company;

began operations of its first 250,000 kw unit in July 1963, and its second unit, also 250,000 kw, in July 1964. Future planning contemplates expansion of this plant to at least a 1,000,000 kilowatt capacity. Annual commerce to this plant for generating 500,000 kw is expected to average 305,000 tons of oil and 405,000 ton of coal during project life. When expansion of the plant to 1,000,000 kw is accomplished, it is estimated that an additional 305,000 tons of oil and 405,000 tons of coal will be added by the final year of project life.

10. The Montaup Electric Company also plans expansion of its generating facilities. The company claims that its new site below Slades Ferry Bridge has sufficient space for installation of a 1,000,000 to 1,500,000 kw capacity plant. Present plans call for construction in the early seventies. Examination of power forecasts reveals that in this area, about 1,000,000 kw capacity will be needed in the near future in addition to that described previously. Therefore, an additional 810,000 tons of coal and 610,000 tons of oil will be added to the commerce upon completion of the power plant by the Montaup Electric Company. Power demand is increasing rapidly in this area. On the basis of Federal Power Commission forecasts these plants will definitely be completed during project life. Therefore, benefits were computed and reduced to an annual average equivalent.

11. Table No. B-3 and B-4 shows estimated future receipts of petroleum products to existing terminals, exclusive of power plant receipts. These receipts are based on demand and population increases, discussed in previous paragraphs. Table No. B-5 summarizes the estimated future annual receipts of all deep draft commerce, in Fall River Harbor. The petroleum receipts in 1964 represent current annual average commerce and reflect quantities of oil received in T-2 or larger tankers. The 1964 commerce thus is indicative of annual average and does not represent actual receipts for 1964. The year 1972 was used as the first year of project life should improvement be authorized and completed.

TABLE NO. B-3

FALL RIVER (BAY CHANNEL)

Year	Receipts (Sh. Tons)		Population Increase Factor		Demand Increase Factor		Petroleum Receipts (Sh. Tons)
1964	1,200,000*						
1972	1,200,000	x	(1 +0.02 x 8 yrs)	x	$\frac{32}{32}$	=	1,392,000
2022	1,200,000	x	(1 +0.02 x 58 yrs)	x	$\frac{40}{32}$	=	3,240,000
2072	1,200,000	x	(1 +0.02 x 108 yrs)	x	$\frac{40}{32}$	=	4,740,000

*Exclusive of power plant receipts

TABLE NO. B-4

Tiverton

Year	Receipts (Sh. Tons)		Population Increase Factor		Demand Increase Factor		Future Receipts (Sh. Tons)
1964	530,000						
1972	530,000	x	(1 + 0.02 x 8 yrs)	x	$\frac{32}{32}$	=	614,800
2022	530,000	x	(1 + 0.02 x 58 yrs)	x	$\frac{40}{32}$	=	1,431,000
2072	5300,000	x	(1 + 0.02 x 108 yrs)	x	$\frac{40}{32}$	=	2,093,500

TABLE NO. B-5

(Estimated Future Receipts (Deep-Draft Vessels)
Fall River (Bay Channel)

Year	Existing Petroleum Terminals	New England Power Co.		Montaup Electric Co.	
		Oil	Coal	Oil	Coal
1972	1,392,000	305,000	405,000	201,000	267,000
2022	3,240,000	610,000	810,000	811,000	1,067,000
2072	4,740,000	610,000	810,000	811,000	1,067,000

Fall River Totals

Year	Totals		Total
	Oil	Coal	Oil and Coal
1972	1,898,000	672,000	2,570,000
2022	4,661,000	1,877,000	6,538,000
2072	6,161,000	1,877,000	8,038,000

Tiverton

Year	Existing Petroleum Terminals	Total Oil and Coal
1972	614,800	614,800
2022	1,431,000	1,431,000
2072	2,093,500	2,093,500

Combined Total - Fall River-Tiverton

Year	Oil	Coal	Total
1972	2,512,800	672,000	3,184,800
2022	6,092,000	1,877,000	7,969,000
2072	8,254,500	1,877,000	10,131,500

12. In addition to the above commerce, the U.S. Air Force Terminal at Tiverton, Rhode Island receives and distributes considerable amounts of petroleum products throughout New England. This agence advises that, during normal peacetime operations, a total of 14 tanker loads and 9 barge loads are the average receipts of this facility. Tanker sizes range from T-2 (16,500 dwt) to 32,000 dwt maximum, at the present time.

13. Vessel Traffic - Tankers and colliers deliver the preponderance of Fall River Harbor commerce. Tanker deliveries are made chiefly in vessels ranging from T-2's (16,500 dwt) to 32,000 deadweight tons. Bituminous coal is delivered in colliers ranging in size from 11,000 to 26,000 deadweight tons. In addition to this traffic, small freighters make several trips annually. The larger tanker deliveries are made in the Tiverton area. The reason for this aspect of navigation lies in the inadequacy of the channel through the Fall River bridges. With drawspans of 98 and 100 feet in width, local interests have found that the navigational hazards involved in attempting passage of any vessel larger than a T-2 or jumbo-sized T-2 are too great for safe navigation.

14. In the event of improvement of the waterway, future vessel traffic will be, as at present, colliers and tankers. There will also be a few freighter trips. These latter vessels draw from 27 to 30 feet and would be unaffected by improvement. Future colliers will be considerably larger than the present vessels. The larger colliers have an overall length of 605 to 634 feet, 70 to 75-foot beam, have a cargo capacity averaging 26,400 short tons and draw 34 feet, fully loaded. As the vessels can deliver bituminous coal at considerably less cost than smaller vessels, it is considered that they will be used exclusively in the future. In the event of improvement, tankers will be of a considerably larger size than are now being used in this locality. The larger ships are being constructed and are replacing T-2's with increasing frequency. For verification of this, comparisons with comparable New England petroleum harbors have been made. For example, the Mystic River in Massachusetts received over 3,500,000 tons of petroleum products in 1961. About two-thirds of this commerce was delivered in tankers ranging in size from 35,000 to 46,000 deadweight tons. It is quite probably that a larger proportion of the commerce would have been carried in the larger size vessels, if available. This statement considers the long haul distance involved in New England ports and consequent higher delivery costs. The commerce originates in Gulf, West Indian, or South American ports which are more distant from New England than all other East Coast ports. For such a distance, transportation costs are comparatively high in the smaller tankers. Thus, oil interests endeavor, whenever possible, to reduce the costs by the use of larger tankers. The only restrictions on the use of larger tankers are first, their availability, and secondly, the ability of harbors to receive them. As stated previously, the larger

ships are being constructed and will be available for more frequent use in future years. Table B-6, following, shows trends in tanker construction for the most recent 7-year period. Table B-7 shows the 1962 composition of the U.S. Tanker fleet, in T-2 equivalents.

TABLE NO. B-6

Trends in Tankers Under Construction (World Fleet)
(Sun Oil Company - Maritime Reporter & Engineering News)

1 September 1963

Date	No.	DWT (thousands)	Average DWT
12/31/56	879	25,488	29,000
12/31/57	1116	37,406	33,500
12/31/58	803	28,464	35,400
12/31/59	523	19,746	37,800
12.31.60	366	15,366	42,000
12/31/61	352	15,737	44,700
12/31/62	324	14,040	43,300

TABLE NO. B-7

U.S. Deadweight Tonnage Distribution (1962)

Under 17,000	17,000 to 29,999	30,000 to 49,999	50,000 and over
34.7%	40.4%	20.8%	*

*Estimated at 10% in 1964

It should be noted that the total of vessels larger than T-2's comprises over 65 percent of the U.S. Fleet. Table No. B-8 shows the trend toward the use of larger vessels in Fall River.

TABLE NO. B-8

Trends in Vessel Draft*

Fall River Harbor

Draft (ft.)	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
35						2		1	1	-	-
34								1	4	6	6
33					1	3	9	1	1	18	32
32	3	3	3	5	5	28	22	5	10	27	31
31	44	44	36	40	31	40	49	48	43	40	39
30	30	29	41	37	40	22	12	35	34	41	34
29	5	9	9	9	8	10	1	3	6	5	9
28	5	2	2	3	1	4	2	1	12	3	5
27	2	-	-	1	2	1	-	-	8	4	2

*Does not include vessel trips to U.S.A.F. Terminal

16. Benefits are evaluated separately for each of the two deep-draft channels. The separation is necessary because both channels function indpendently and have dissimilar navigational problems. In the Tiverton channel it is now possible to deliver petroleum products in a 32,000 dwt tanker. These vessels draw 34 feet, fully loaded, and can deliver 34,300 short tons of cargo to this harbor. As the existing channel depth is 35 feet, this type of vessel operates only over extreme high tidal periods. Should the vessels arrive at the channel at time other than high water, waiting is necessary until such time as there is sufficient tide to allow adequate hull-clearance for safe navigation. The waiting times are called tidal delays and added to transportation costs of the delivered products. The additional costs reflect the hourly operating costs of the vessel delivering the products. Benefits for the elmination or reduction of tidal delays are based on average waiting time for the vessels. A typical tidal delay curve is shown at the end of this appendix. Additional benefits will result from the ability to deliver products directly by deeper draft vessels and at lower costs per ton.

17. Similar to the Tiverton channel the existing 35-foot deep Bay channel would allow for a 32,000 dwt tanker. However, local interests have found that safe navigation precludes their passage through the bridges, and use no larger than a Jumbo T-2 tanker (20,000 dwt). In view of this aspect of navigation, benefits have been evaluated for the savings to be realized by using 32,000 dwt tankers in lieu of 20,000 dwt and have been attributed to bridge alteration. Benefits to be realized by deepening the existing 35-foot channel were based on the ability to use larger than 32,000 dwt tankers in a deeper channel, and exclude benefits resulting from the change from T-2 and Jumbo T-2 tankers to 32,000 dwt tankers.

18. Docking and undocking procedures for all sections of the harbor entail the use of 2 to 3 towboats. Improvement, by enabling the larger ships to navigate the waterway, would allow for delivering an annual volume of products in fewer vessel trips, thus reducing the annual costs of towboat hire. The amount of the reduction is taken as an annual benefit, attributable to navigation improvement.

19. Prior to evaluating benefits for future commerce to the power plants, it was considered that the claims of local power interests should be substantiated. It was considered also that the future competitive effects of nuclear power versus conventional power should be investigated. This latter phase of future power demand is treated in a separate appendix.

20. Federal Power Commission's estimates of future demand were solicited. The Commission does not forecast future demand for individual companies or specific municipalities but forecasts future demand for large areas. The tributary area for this locality lies in Power Supply Area No. 2 of Federal Power Commission definition. This area encompases all of the New England States, except Maine. The forecasts are made for 20-year periods only and the latest forecast available, made in 1960, includes the year 1980. The following table shows anticipated future demand and energy requirements.

TABLE NO. B-9

POWER SUPPLY AREA NO. 2
(NEW ENGLAND LESS MAINE)

Year	*Demand (Megawatts)	*Energy (Million kwh)
1940	1,886	7,870
1950	3,279	14,932
1960	5,616	27,388
1961	6,002	29,129
1970	10,400	52,250
1980	18,700	95,000

*1940 - 1961 represents actual use, 1970 - 1980 estimated

21. From the preceeding table of Federal Power Commission power demand forecasts, it may be seen that power demand in 1980 will be about 80 percent greater than in 1970 for Power Supply Area #2. Assuming that this locality's demand is comparable to the entire area it is estimated that additional capacity of at least 665,000 kw would be necessary for that year. In view of the favorability of the location on tidewater, it is estimated that at least an additional 750,000 kw capacity will probably be installed by 1980. This represents a 90 percent increase over the 1972 installed capacity and will result in the first 8 years of project life. In consideration of this increase and with allowances made for changes

in types of generation it is estimated that a further 750,000 kw of fossil fuel generation will be installed during project life. For conservatism and simplicity of benefit computations, the above estimated rate of growth was scaled downward, and a uniform growth assumed over the entire project life to a total of 1,500,000 kw by the 50th year of project life. Further increases in power capacity will be attained, but it is believed that the future gains will consist mostly of nuclear generation. Therefore, benefits for power plant commerce were computed and reduced to an average annual equivalent on a straight line growth basis as described above.

22. Transportation costs are based on hourly operating costs of vessels for the round trip time from ports of origin to Fall River Harbor. A 24-hour allowance is made for unloading. The following Table No. B-10 shows the operating costs of specific vessels as derived from published data.

TABLE NO. B-10

Characteristics of Ocean-Going Tankers and Colliers

Dead Weight (Long Tons)	Length	Beam (feet)	Design Draft	Speed (knots)	Operating Costs (Dollars per hr) U.S. Flag At Sea	U.S. Flag In Port	Foreign Flag At Sea	Foreign Flag In Port	Fuel/Day (Long Tons)
					$	$	$	$	
20,000 Jumbo		77	30'-2"	14.5	179	171	104	97	44
25,000	577	79	33'-6"	16	217	210	133	125	64
29,000	627	83	33'-2"	17	247	217	144	135	71
32,000	654	86	34'-2"	17	260	249	156	147	75
35,000	667	90	34'-6"	17	274	263	166	157	76
40,000	715	93	36'-7"	17	290	278	177	167	89
46,000	737	103	38'-0"	17	305	292	188	178	92
50,000	733	102	38'-9"	17	330	315	205	194	98
Colliers	605	75	33'-11"	16	216	188	---	---	50

24. The data in Table No. B-10 were used in estimating per-ton delivery costs for delivery of petroleum products from Gulf and South American ports and for delivery of coal from Norfolk, Virginia. Typical computations of delivery costs follow:

Port of Origin - Norfolk, Va.
24,000 dwt collier

Basic Data

Distance 450 nautical miles
Crusing Speed 16.0 knots

Hourly Operating Costs

At sea	$216
In port	188

Rd. trip @ sea $\frac{900}{16 \times 24}$ = 2.34 days

Cost rd trip @ sea ($216 x 24 x 2.34) = $12,130
Add 1d day in port ($188 x 24) = 4,512
Total Trip Cost $16,642

Deadweight Tons 24,000 - 140 (Fuel) - 250 (stores, etc.) = 23,610 Long Tons

Cargo 23,610 x 1.12 = 26,443 sh. tons

$16,642/$26,443 = $0.63/short ton

TYPICAL DERIVATION OF PETROLEUM
DELIVERY COSTS
(U. S. REGISTRY)

Tanker Class 50,000 dwt	40-foot channel
Av. Dist. (Gulf Ports)	2100 nautical miles
Crusing speed 17 knots	draft 39'
17 x 24 = 408 nautical miles/day	fuel = 98.3 LT/day

$\frac{2100}{408}$ = 5.15 days

5.15 x 2 = 10.3 days (rd. trip @ sea)

Fuel = 98.3 x 10.3	1012
Add 5 days extra fuel	493
Add fuel in Port	40
Stores, water, etc.	250
	1795 Long tons

50,000 - 1,795 = 48,205 Long tons net cargo
48,205 x 1.12 = 53,990 Short tons net cargo
Hourly operating costs @ sea $330, in port $315
$330 x 10.3 x 24 = $82,091 (rd trip @ sea)
1 day in port 24 x $315 - $7,560
Sub-total - $89,651
Tidal delay 4.9 hours x $330 - $1617
Trip Cost - $89,651 + $1,617 = 91,268

$\frac{91,268}{53,995}$ = $1.69/Short Ton

25. In computation of benefits, allowances were made for the necessary time element between submission of a report and completion of the project. A conservative estimate of the time required would allow for authorization and funds appropriated for project construction. On this basis the first full year of improvement would be in 1972. Therefore, benefits were evaluated for that year and for a 50 year project life.

TABLE B-11

FALL RIVER HARBOR

Transportation Costs, for Channels of Various Depths (Petroleum)

	35'			37'			38'			40'			45'		
Tanker Size(DWT)	Tonnage (1000 Sh.T.)	Cost/ Ton	Total Costs(000)	Tonnage (1000 Sh.T.)	Cost/ Sh.Ton	Total Costs(000)	Tonnage (1000 Sh.T.)	Costs/ Sh.T.	Total Costs(000)	Tonnage (1000 Sh.T.)	Costs/ Ton	Total Costs(000)	Tonnage (1000Sh.T.)	Cost/ Ton	Total Costs(000)
	1972					Commerce Above Bridges (Domestic)									
20,000 (Jumbo)	1030	2.63	2709												
32,000	1030	2.07	2132												
35,000				1030	1.96	2019	1030	1.96	2019	1030	1.96	2019	1030	1.96	2019
	2022														
20,000 (Jumbo)	2398	2.63	6306												
32,000	2398	2.07	4964												
35,000				2398	1.96	4700	1199	1.96	2350	1199	1.96	2350	1199	1.96	2350
40,000							1199	1.93	2314						
50,000										1199	1.69	2026	1199	1.66	1990
	1972					Commerce Above Bridges (Foreign)									
20,000	563	1.53	861												
32,000	563	1.25	703												
35,000				563	1.20	676	563	1.20	676	563	1.20	676	563	1.20	676
	2022														
20,000	1042	1.53	1594												
32,000	1042	1.25	1302												
35,000				1042	1.20	1250	521	1.20	625	521	1.20	625	521	1.20	625
40,000							521	1.18	615						
50,000										521	1.05	547	521	1.04	542

TABLE B-12

Transportation Costs, for Channels of Various Depths (Petroleum)

Tanker Size DWT	35 Tonnage (1000ShT)	35 Cost/ Ton	35 Total Cost(000)	37 Tonnage (1000 ShT)	37 Cost/ Ton	37 Total Cost(000)	38 Tonnage (1000 ShT)	38 Costs/ Ton	38 Total Cost(000)	40 Tonnage (ShT 1000)	40 Costs/ Ton	40 Total Cost(000)	45 Tonnage (1000 ShT)	45 Cost/ Ton	45 Total Cost(000)
						Commerce below Bridges (Bay Channel) (Foreign)									
	1972														
32,000	305	1.25	381												
35,000				305	1.20	366	305	1.20	366	305	1.20	366	305	1.20	366
	2022														
32,000	1220	1.25	1525												
35,000				1220	1.20	1464	610	1.20	732	610	1.20	732	610	1.20	732
40,000							610	1.18	720						
50,000										610	1.05	641	610	1.03	628
									1452			1373			1360
							Tiverton Channel (Domestic)								
	1972														
32,000	615	2.07	1273												
35,000				615	1.96	1205	615	1.96	1205	615	1.96	1205	615	1.96	1205
	2022														
32,000	1431	2.07	2962												
35,000				1431	1.96	2805	715	1.96	1401	715	1.96	1401	715	1.96	1401
40,000							116	1.90	1360						
50,000										716	1.69	1210	716	1.66	1189
									2761			2611			2590

26. Benefits for petroleum commerce are based on the savings in transportation costs to be realized by the ability to use larger tankers in an improved channel. The computation of such benefits consists essentially of comparing the overall costs of delivering the petroleum products in the maximum size vessel that can be used in the existing channel, with the lower costs of delivering the same volume of petroleum products in the larger vessels that can be used in an improved channel. The differences in costs are considered benefits attributable to improvement. Benefits were developed for incremental depths of 37, 38, 40 and 45 feet. In computation of the benefits, tidal delay costs were added to the per-ton delivery costs for the tankers involved in the various depths. Therefore no further cognizance was taken of tanker tidal delays in further benefit evaluations. This procedure avoids any possible duplication of benefits.

27. Tables Nos. B11 and B-12, following, show the types of tankers estimated to be used and the transportation costs involved, both under existing conditions, and with improved conditions, should the project be authorized. Table No. B-13 summarizes the savings for each channel depth considered. Table No. B-14 summarizes the benefits for petroleum commerce. Differences in costs have been tabulated for the various channels involved. The anticipated petroleum receipts have been divided into two categories, domestic and foreign. This procedure is necessary as transportation costs for domestic tankers are higher than for similar foreign tankers. Consequently incremental differences vary and transportation savings to be realized vary accordingly. In determination of the amount of commerce to be received for each category, past commercial statistics were reviewed. It was found that one oil terminal above the bridges normally receives about 74 percent domestic products and 26 percent foreign products. Future commerce to this terminal, was estimated on that basis. The remaining petroleum distributing terminals receive domestic petroleum products. Power plant fuel is imported either from Venezuela or West Indian ports. Therefore, all future oil receipts to the power plants were carried as foreign commerce. It is not considered that the larger vessels will come into univeral use immediately after improvement, but will replace smaller ones at an even rate over project life. Therefore benefits are based on the assumption that in the first year of project life the commerce will be carried in 35,000 dwt tankers in any improved channel, as compared to the maximum 32,000 dwt tanker which can be used in the present 35-foot channel. It is also considered that larger vessels will be used exclusively by the 50th year of project life. Benefits for the larger vessels are based on a combination of 35,000 and 50,000 dwt tankers in that year. Equal use of each type was assumed. The increase in benefits over the project life thus computed were reduced to an average annual equivalent. This estimate of tanker size is considered conservative as it is believed that terminal interests will endeavor to us' the largest vessel size possible in order to realize more econom al transportation costs. Tables Nos. B-11, B-12, and B-13 show tr portation costs and savings to be attained.

TABLE NO. B-13

FALL RIVER

Transportation Costs, Channels of Various Depths

Channel Depth	Transp. Costs ($1,000)	Savings vs 35' Channel ($1,000)	
	Bay Channel	(Above Bridges)	Domestic
1972			
35' (W/Bridges)	2709		
35' (W/O Bridges)	2132	577	
37'	2019	113	
38'	2019	113	
40'	2019	113	
45'	2019	113	
1972	Bay Channel	(Above Bridges)	Foreign
35' (W/Bridges)	861		
35' (W/O Bridges)	703	158	
37'	676	27	
38'	676	27	
40'	676	27	
45'	676	27	
1972	Bay Channel	(Below Bridges)	Foreign
35'	381		
37'	366	15	
38'	366	15	
40'	366	15	
45'	366	15	

Channel Depth	Transp. Costs ($1,000)	Savings 35' Channel ($1,000)	Savings Increase 1972-2022 ($1,000)	Ann Av Equiv ($1,000)
2022	Bay Channel	(Above Bridges)	Domestic	3.125%
35' (W/Bridges)	6306			0.3866
35' (W/O Bridges)	4964	1342	765	296
37'	4700	264 - 113	151	58
38'	4664	300 - 113	187	72
40'	4376	588 - 113	475	184
45'	4340	624 - 113	511	198

Channel Depth	Transp. Costs ($1,000)	Savings 35' Channel ($1,000)	Savings Increase 1972-2022 ($1,000)	Ann Av Equiv ($1,000)
2022	Bay Channel Above Bridges (Foreign)			
35' (W/Bridges)	1594			
35' (W/O Bridges)	1302	292	134	52
37'	1250	52 - 27	25	9
38'	1240	62 - 27	35	14
40'	1172	130 - 27	103	40
45'	1167	135 - 27	108	42
2022	Bay Channel (Below Bridges) Foreign			
35'	1525			
37'	1464	61 - 15	46	18
38'	1452	73 - 15	58	22
40'	1373	152 - 15	137	53
45'	1360	165 - 15	140	54

Channel Depth	Trip Costs ($1,000)	Diff. v.s. 35' Channel ($1,000)	Increase 1972-2022 ($1,000)	Ann Av. Equiv ($1,000)
	Tiverton Channel			
1972				
35'	1273	68		
37'	1205	68		
38'	1205	68		
40'	1205	68		
45'	1205	68		
2072				
35'	2962			
37'	2805	157 - 68	89	34
38'	2761	201 - 68	133	51
40'	2611	351 - 68	283	109
45'	2590	372 - 68	304	118

Benefits for Bridge Alteration*

COMMERCE

Year	Domestic ($1,000)	Foreign ($1,000)	Total ($1,000)
1972	577	158	735
2022	296	52	348
	873	210	1083

*Benefits for Bridge Alteration constant for all channels and similar for pipeline installation.

TABLE B-14

BENEFIT SUMMARY - PETROLEUM COMMERCE

50-YR. LIFE

Bay Channel - Domestic

	37'Channel $ (000)	38'Channel $ (000)	40'Channel $ (000)	45'Channel $ (000)
Benefits 1972 (Continuous - 50 Yrs.)	113	113	113	113
Incremental Benefits (1972-2022)	58	72	184	198
Total	171	185	297	311
50% Domestic Benefits allocated to Ports of Origin	85	92	148	155
Net Domestic Benefits	86	93	149	156
Bay Channel - Foreign				
Benefits 1972 (above bridge)	27	27	27	27
Benefits 1972 (below bridge)	15	15	15	15
Benefits 2022 (above bridge)	8	14	40	42
Benefits 2022 (below bridge)	18	22	53	54
Total Foreign	68	78	135	138
Total Bay Channel Benefits	154	171	284	294
Tiverton Channel - All Domestic				
Benefits 1972 (Continuous - 50 Yrs.)	68	68	68	68
Incremental Benefits (1972-2022)	34	51	109	118
Total	102	119	177	186
50% allocated to Ports of Origin	51	59	88	93
Net Benefits	51	60	89	93
Total Benefits (both channels)	205	231	373	387

28. In addition to the benefits to be derived from the petroleum commerce, substantial benefits will be realized from current and future bituminous coal commerce. This commerce will be carried in 24,000 dwt super colliers. The vessels carry 26,500 short tons of cargo and draw 34 feet loaded summer draft. With this draft navigation of the 35-foot existing channel is possible only over high tidal periods. Usually, a vessel entering the harbor is forced to wait for such high water periods. Its waiting time varies with the tidal stage and can entail somewhat over 10 hours, maximum. Using mean tidal curves for the locality the average waiting time for these vessels was computed. It was found to be 4.9 hours. Hourly operating costs for the vessel at sea are $216. Thus the total average delay costs are 4.9 x $216 or $1,058. Reduced to a per ton basis the delay cost is $0.04. Deepening to 40 feet would eliminate tidal delays as the vessels could then enter at any stage of the tide. Therefore, benefits to be realized from the coal commerce were computed using this figure.

29. It is estimated that the New England Power Company's new 500,000 kw generating plant will require 405,000 tons of bituminous coal, annually, from the start of the project life. Annual benefits to be realized throughout the project life will be $0.04 x 405,000 or $16,200. Commerce to the existing Montaup plant will average 267,000 tons of coal annually. Annual beenfits from this source total $10,600.

30. Future coal commerce will also benefit by improvement. As the new plant will be expanded to 1,000,000 kw and an additional 1,000,000 kw capacity will be added by Montaup Electric Company's new plant, an estimated additional 1,215,000 tons of coal will be carried annually upon completion of the plants. Benefits for this commerce will be $0.04 x 1,215,000 or 48,600 by the 50th year of project life. Reduced to an annual average equivalent at 3.125 percent the benefits are $18,800 over a 50-year project life. These benefits combined with the $26,800 benefits for the existing plants result in a total of $45,600. Similar computations were made for each channel depth considered. Coal and petroleum benefits are summarized in Table B-15.

31. In the year 2022 petroleum receipts in the Bay Channel are anticipated to reach a total of 4,661,000 tons. If this tonnage were carried in 32,000 dwt vessels, with a cargo capacity of 34,300 tons, 136 vessel trips would be required. After improvement the same tonnage, if carried in a combination of 35,000 and 50,000 dwt vessels could be delivered in 105 trips, assuming that 50 percent of the total was carried in each class. Thus a total of 31 vessel trips could be eliminated with consequent reduction in annual towboat hire. Average towboat costs are $1240 per vessel trip, which includes docking and undocking. Total savings would thus be $1240 x 31 or $38,440. As this saving would be realized in 2022, reduction to its annual average equivalent becomes $14,900, an average annual benefit.

32. Similar benefits were computed for the Tiverton Channel. The 2022 commerce of 2,093,000 tons could be delivered in 61 trips of 32,000 dwt tankers. The combination of 50,000 and 35,000 dwt tankers could deliver the same commerce in 48 trips, thus saving 13 trips. For this part of the harbor, towboat cost per trip is $1,200. Total savings would be $15,600 which when reduced to its annual average equivalent would be $6,000 over a 50-year project life.

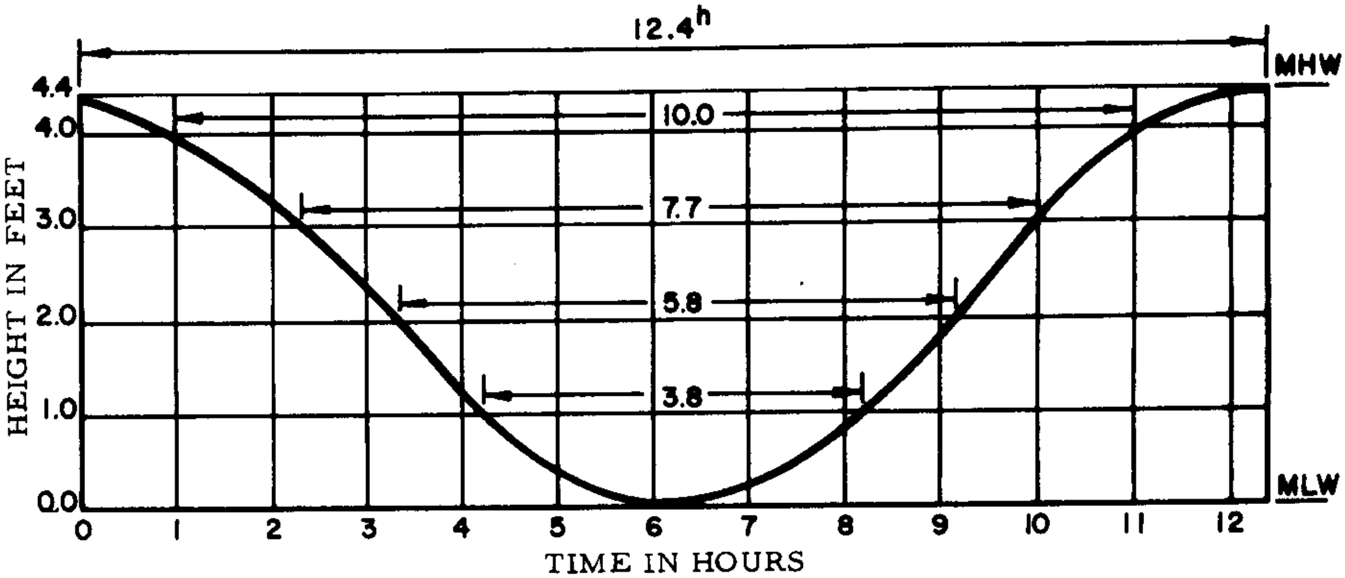
TABLE NO. B-15

SUMMARY OF BENEFITS

	Bay Channel			
Petroleum	154	171	284	294
Coal	27	46	46	46
Towboat	6	8	15	16
Total	187	225	345	356
	Tiverton Channel			
Petroleum	51	60	89	93
Towboat	2	2	6	5
Total	53	62	95	98
Bridge Alteration	1083	1083	1083	1083
Combined Project	1323	1370	1523	1537

FALL RIVER HARBOR, MASS.

MEAN TIDE CURVE



Note: Figures within curve indicate hourly delays for vessels needing the tidal heights shown

(Add 1 hour for transit time mouth to dock)

Typical Delay Computation
(35' channel, 34' draft, 5' clearance)
Tidal Ht. Required 4'.0
Transit time to dock 1^h
Delay time (from curve) 10^h

$\frac{11.0}{12.4} \times \frac{11.0}{2} = 4.9^h$ (Av. Delay this type of vessel)

ADDRESS ONLY THE
REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
59 TEMPLE PLACE
BOSTON, MASSACHUSETTS

NORTHEAST REGION
(REGION 5)
MAINE
NEW HAMPSHIRE
NEW YORK
VERMONT
PENNSYLVANIA
MASSACHUSETTS
NEW JERSEY
RHODE ISLAND
DELAWARE
CONNECTICUT
WEST VIRGINIA

June 28, 1961

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Dear Sir:

Reference is made to your letter of May 19, 1961 in which you advised us that you are preparing a navigation report for Fall River Harbor, Rhode Island and Massachusetts and that a public hearing would be held on June 22, 1961. This letter constitutes our conservation and development report on the fish and wildlife aspects involved and has the concurrence of the Massachusetts Divisions of Fisheries and Game, Marine Fisheries and the Rhode Island Division of Fish and Game. This report also expresses the views of the Bureau of Commercial Fisheries.

The existing project provides for a channel 35 feet deep, 400 feet wide from deep water in Mount Hope Bay easterly into Tiverton Lower pool, thence northerly along the Tiverton waterfront to the Gulf Oil Company's wharf and southerly to Bay Oil Company's wharf respectively; a channel 35 feet deep, 400 feet wide from deep water in Mount Hope Bay northeasterly to Globe Wharf, thence to the wharves above the bridges with increased width at the bends; a turning basin 35 feet deep, about 1,100 feet wide and 850 feet long, above the bridges, between the Shell and Montaup Wharves; a 25-foot anchorage, west of the harbor channel; a channel 30 feet deep and generally 300 feet wide extending about one mile below Slades Ferry Bridge, east of the harbor channel; and the removal of rock to 30 feet in the lower end of Hog Island Shoal. The existing project has been completed except the rock removal at Hog Island Shoal. The public hearing is being held to determine if it is advisable to modify the existing project in Rhode Island and Massachusetts in any way at this time, particularly with respect to provision of 45-foot depth. It is our understanding that the spoil material from the project will be dumped at sea.

No commercial fishery benefits are anticipated as a result of the project. This Bureau concludes that there would be no adverse effects on fish and wildlife resources as a result of project construction.

No further studies by this Bureau will be required unless there is a change in spoil disposal plans. Should the spoil disposal plans change significantly we would like to have notification sufficiently in advance of contract letting to prepare a new fish and wildlife report.

It is requested that this report become a part of the record of the public hearing.

Sincerely yours,

M A Marston

M. A. Marston
Acting Regional Director

APPENDIX D

LONG DISTANCE PIPELINES

1. This appendix discusses current pipeline construction and its probable effects on future tanker delivery of petroleum products to New England ports. A pipeline, Colonial Pipeline, Inc., has been completed from Texas to New York, with its extension to New England mentioned as a possibility. As it is believed in some quarters that such a line would eventually replace tanker traffic, in this area study of available data was made.

2. The evaluated data include the following reports and published articles:

a. "Estimate of the Impact of Colonial Pipeline on Activity of the United States Tanker Fleet", Report by Ernst & Ernst, for Shipbuilders Council of America, 1730 K Street N.W., 1701 K Street N.W., Washington, D.C. 20 June 1962.

b. "Old pipeline proposals may be revived", The Oil and Gas Journal, 13 November 1961, pp. 129 and 130.

c. "Silent Pipelines in Freight Role" (Associated Press) The Christian Science Monitor, 19 November 1962.

d. "Products lines to New England being studied", the Oil and Gas Journal, 20 November 1961, p. 145.

e. Colonial Pipeline Company, "Local and joint tariff applying on petroleum products" (23 March 1966) I.C.C.NO. 4.

f. "Big Pipe to East may short-cut tankers", Business Week, 17 March 1962, pp. 29-30.

3. Transportation Costs. The main reason for changing from tanker to pipeline delivery is reduction in delivery costs of petroleum products. This reason applies particularly to locations removed from deep draft harbors where rehandling and secondary costs are involved. The possibility of a reduction in petroleum delivery costs to New England is discussed in the following paragraphs.

4. Published tariffs of pipeline delivery from Beaumont, Texas range from $0.2315/bbl to Atlanta, Georgia to $0.3305 to Port Socony, New York. The petroleum products involved are light oils, ranging from gasoline to No. 2 fuel oil. On a tonnage basis, the New York delivery price would be about $2.41 including a profit factor of 10 percent or $2.20 cost. Per ton delivery costs are $2.63 in Jumbo T-2S (20,000 dwt) and $2.07 in 32,000 dwt tankers.

5. The previously described costs pertain to current movements of the products. Future delivery costs of the pipelines are expected to decrease as the pipeline is amortized and debt is reduced. Conversely, tanker delivery costs are expected to increase. The increase will result from higher construction costs of vessels, with consequent higher fixed costs. The report by Ernst & Ernst, (paragraph 2a) estimates that such tanker costs will increase by about 15 percent and pipeline costs will decrease by about $0.05/bbl. This would indicate future costs of about $1.96 per ton for the pipeline commerce at New York and $2.24 per ton to Boston. For future tanker costs the averages would be $1.94 for 50,000 dwt, $2.30 for 32,000 dwt., and $3.62 for T-2's.

6. To date, plans for extending the pipeline into Boston are strictly in the talking stage. No definite construction plans have been announced. Should the pipeline be extended to Boston, it is considered that higher unit costs of construction would be involved. This consideration is based on the more populous nature of the area, with relatively high costs of land acquisition and proportionally higher local taxes. In this event, tariffs for delivery from the present terminus in New York, to Fall River area would be relatively higher on a per mile basis.

7. The Ernst and Ernst report also finds that present rates of delivery to North Atlantic ports is more economical by tanker. However, the report does bring out one salient fact, which appears to justify participation of the major oil companies in construction of the pipeline. In locations where oil deliveries are made to deep draft tidewater terminals and then transferred by rail, truck or barge, to secondary terminals and rehandled for delivery to retail outlets, pipeline delivery by spur from the trunk line is much more economical. Since the route of the pipeline is quite a distance inland for the greater part of its length, it appears that the major economies to be derived from its construction will be derived from this inland source. This aspect of the pipeline's economy benefits the inland areas of the Southeastern and Middle Atlantic States. Also, it is probable that tidewater tanker deliveries to southeastern ports, normally subject to secondary transportation, will be curtailed, probably accounting for the much publicized retirement of a considerable portion of the U. S. Flag tanker fleet. The availability of these ships could cause a reduction in tanker delivery costs to New England ports.

8. In New England a large proportion of retail deliveries is handled directly from large deep water terminals, without rehandling through secondary terminals. Therefore the major potential advantage of the long distance pipeline, namely elimination of transportation to secondary terminals, would not be as pronounced in this area. Thus, it is considered questionable at this time whether the extension of the pipeline to Boston could be economically justified.

9. In summary, it is believed that at the present time the pipeline tariffs about equal Jumbo T-2 costs, as computed for Fall River Harbor. In point of fact the larger tankers can deliver petroleum products to this area more economically than pipeline alone or any combination of pipeline delivery to New York, rehandling and shipping by tanker or pipe to New England. There may be a future decrease in delivery costs to New York and increased costs to constructing future tankers. Even with the estimated decreased cost of pipelines and increased costs of tankers, the delivery costs for the large tankers would be more economical in this area. The increased costs for tankers do not recognize any future improvement in the design, efficiency, or future speed of tankers, or the effect of pipeline competition. Any one of these factors could serve to keep delivery costs for tankers to little more than present levels. In addition, future pipeline improvement costs would be higher than at present. Of course, no additional land takings would be necessary, which would serve to keep overall costs relatively lower. While this is true, it is believed that future pipeline extensions would involve large construction costs which would tend to keep future delivery costs at about the same relative plane comparable to future tanker delivery costs. It is believed that large tankers now in use will continue to have an economic advantage over pipelines for petroleum deliveries to New England from ports on the Gulf Coast.

10. Pipeline Capability. At present, pipeline construction could only affect refined products now shipped from Gulf ports. (There are future possibilities of pipeline transportation from western or Canadian oil fields, which could not be carried by tankers in any case, but this probably will not become economical until southwestern oil sources are depleted). The pipeline from Texas to New York could affect only those products shipped from Gulf ports. Products involved are gasoline, kerosene, and distillate light fuel oils. Maximum capacity is 800,000 bbl/day, and can be increased to 1,000,000 bbl/day, with comparatively minor modifications to the pumping stations. The route is mostly inland with spur lines extending to the principal populous areas adjacent to its route.

11. New England consumption of these products is greater than the capacity of this pipeline now, and is rapidly increasing. However, as noted above, the economic advantage of the pipeline is greatest in inland areas of the Southeast and Mid-Atlantic States, where present consumption is also greater than the pipeline's capacity. It appears that construction of additional capacity and extension to New England would be necessary before there would be any effect on tanker traffic to New England.

12. The pipeline is not capable of handling heavier fuels, which have a high viscosity. Tankers will be needed for this traffic as long as the heavier fuels are cheaper than other fuels. A large portion of the petroleum products received in Fall River Harbor are residual fuels.

Because residual fuels are the left overs from the refining process, they are priced to meet competitive fuels. It is therefore considered residual fuels will continue to be competitive, and will be used for fuel until refineries reach 100 percent efficiency or until crude supplies are depleted, and replaced by other fuels.

13. Tankers will also be necessary to import petroleum. Domestic supplies are decreasing, foreign supplies are increasing, and pipelines from overseas oil sources are not yet practical. Although New England imports are presently limited by quotas, it appears that future New England fuel requirements will be supplemented by increased fuel imports.

14. Other Factors. The most important factor that will affect the use of tankers or pipelines for future petroleum deliveries to New England will be the effect of Federal policies. Tax advantages to domestic oil producers for plant investments in pipelines, subsidies for oil production, and import quotas will act to increase the economic advantage of pipelines. Continued subsidies for domestic tanker construction, relaxation of import quotas to reduce New England fuel costs, trade or aid agreements with foreign oil producing countries, all will act to increase the use and economic advantage of deep-draft tankers. All of these policies are under discussion and future changes are inevitable. However, on the basis of the foregoing, policy changes are not apt to substantially reduce the use of deep-draft tankers for New England petroleum deliveries.

APPENDIX E

FUTURE ROLE OF NUCLEAR POWER IN NEW ENGLAND

1. In view of the recent rapid advances made in development of nuclear power for electrical generation, this appendix will discuss its future role in the New England utility load, particularly as it applies to Fall River Harbor. At the present time in New England there is one nuclear plant in operation, one under construction and several more in the planning stage. These plants are joint ventures of several New England electrical utility companies. The New England Power Company, operator of the recently completed 500 megawatt conventional plant in Fall River Harbor, is a participant.

2. The existing nuclear plant is situated in Rowe, Massachusetts, which is a small municipality in the northwestern part of the State. Originally the plant was licensed for a capacity of 136 megawatts. In November 1962, following the first refueling, the Atomic Energy Commission granted permission to increase reactor output to 156 megawatts. In 1964 an output record of 185 megawatts was reported. Construction costs of the plant totaled $55,000,000 of which $5,000,000 was granted by the Atomic Energy Commission. Under original licensing, production costs were estimated at about 15 mills per kilowatt hour. With the increase in output production costs are now in the vicinity of 7 to 10 mills per kilowatt hour. This plant was a prototype of future plants and utilized a pressurized water reactor for providing steam. As a result of the performance of this plant, the several companies in this venture decided to construct a second plant.

3. The second nuclear plant, now under construction, is located at Haddam, Connecticut. Capacity of this plant will be in the vicinity of 600 megawatts. Present planning envisions commencement of operations in 1968. Power production costs are estimated to be 7 mills per kilowatt hour. This compares with conventional generating costs of 4 to 6 mills.

4. In 1961 the demand for electrical power according to Federal Power Commission statistics was 6,002 megawatts in all of New England except Maine. In 1970 the demand in the same area, by Commission forecasts, will be 10,400 megawatts and 18,700 megawatts in 1980. This represents a 200 percent increase over the 1961 demand. To supply a large part of the demand a combine of utility companies plan at least 11 new power plants. The plants are scheduled to be in operation by the early seventies. The first unit of one of these is located in Fall River Harbor and completed in 1965. It is a conventional plant which will be expanded from its present capacity of 500 megawatts to 1,000 megawatts. Another plant, also conventional, is under construction. This plant is located at Sandwich, Massachusetts near the east entrance to the Cape Cod Canal. Initial capacity of the plant will be 540 megawatts.

Of the remaining plants, depending on the success of the second nuclear plant, 3 will utilize nuclear power, 5 will be conventional, and 1 pumped storage.

6. Undoubtedly nuclear fueled power plants will play an increasingly more important role in meeting future power demands in New England. The plant now in operation has provided and the second under construction will continue to provide valuable information on the type of reactor best suited for this locality. Similar information is being obtained from various other types of reactors. Until such time as the power industry determines the most efficient type of reactor, nuclear power plant construction will probably proceed at a cautious rate. In the meanwhile the continually expanding power demand will have to be served. This will be accomplished by expansion of existing conventional plants and construction of additional others.

7. Most of the nuclear plants, now in operation or planned for construction, are located in areas removed from population centers. This poses a distinct problem for the planning of large installations by utility companies. The high cost of transmission lines and resultant transmission losses contribute to product costs of the utilized power. Availability of large volumes of cooling water poses difficulties. On the other hand fossil fuel plants, located on the coast near load centers enjoy a distinct advantage in that transmission costs and power losses are minimized. This advantage is in addition to whatever economic gains fossil fuel plants experience by locating on tidewater with resultant lower delivery costs of fuel.

8. Based on experience to date in nuclear generating plants, it appears that future installations of them will increase at a higher percentage rate. However, it is also certain that expansion of existing conventional plants and construction of new ones will be necessary to meet the rapidly expanding demand. For this reason it is believed that the two conventional plants planned for Fall River Harbor will be constructed in the early part of project life.

APPENDIX F

Agreement between the Acting Division Engineer, New England Division, Corps of Engineers, and the Commissioner, Massachusetts, Department of Public Works on Cost Apportionment for Future Brightman Street Bridge Alteration.

29 December 1966

1. General. This agreement summarizes all aspects of cost apportionment, in accordance with provisions of the Truman-Hobbs Act (Public Law 647, 76th Congress, amended 16 July 1952) for the proposed alteration of the Brightman Street Bridge over the Taunton River, Massachusetts. The costs will be shown in the Fall River Harbor Survey Report scheduled for submission in January 1967.

2. Basis of Estimates.

a. The cost estimates to be shown in the report are for purposes of authorization only. They are used to show the method of application of the law, the scope of the work, and the degree of participation by the Commonwealth and the Corps of Engineers. The exact costs and allocations will be determined at the time of construction, should authorization be made and funds appropriated for construction.

b. The costs to be apportioned will be limited to those costs that would be involved in alteration of the existing bridge regardless of any election by the Commonwealth of Massachusetts to construct a new bridge in lieu of altering the existing bridge. Only those portions of the cost of removal of the existing bridge and construction of the new bridge which would be equal to that part of the old bridge which would require removal and alteration will apply.

c. After completion of alteration and final settlement of costs thereof the Corps of Engineers will have no further interest in further construction or maintenance of the bridge.

d. The Commonwealth of Massachusetts will contract for the new work which will not be initiated until sufficient funds are available for the Corps of Engineers' share of construction costs.

e. All estimates herein are based on 1966 price levels.

f. It is not considered that any parts of the old bridge are of salvable value. Should the contractor's bid contain an item for this aspect of construction, allocation of costs will be determined thereto.

g. Partial payments will be made to the Commonwealth as the work progresses. On this basis no interest during construction is considered.

3. Land. No land taking will be involved in the bridge alteration. Therefore no costs have been estimated for this phase of the work. Should land be required because of relocation, betterment or for the convenience of the Commonwealth, it shall be the liability of the bridge owner.

4. Capital cost of existing bridge. It is agreed that a fair and workable definition of Actual Capital Cost is the cost at time of original construction of the bridge or portion thereof to be altered, plus additions, minus retirements.

5. Used service life.

a. Straight-line method of depreciation. The straight-line method of computing accrued depreciation will be used in determining the used service life, using the actual capital costs, less salvage.

b. The useful life of the entire structure will be taken as 75 years. This figure is consideration of different life spans of the various components, such as substructure, superstructure, fenders and operating machinery.

6. Removal of existing drawspan. The cost of removing the existing drawspan will be pro-rated between the Government and the Commonwealth, on the basis of the expired service life of the various components thereof.

7. Increased costs of maintenance, repairs, and operation of the new drawspan and its removal, renewal and salvage. Neither the Government nor the Commonwealth will claim any credit for

changes in the cost of maintenance, repairs, or operation of the new drawspan. The Commonwealth waives any claim to a credit for the cost of future removal and renewal of the new drawspan at the end of its useful life and the Government in turn, waives any interest in and claim to a credit for the salvage value of the new drawspan.

Reviewed & Approved

Edward J. Ribbs

E. J. RIBBS, Commissioner
Massachusetts Department
of Public Works

Dated: 29 December 1966

Remi O. Renier
Colonel, Corps of Engineers
Acting Division Engineer

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

DEPARTMENT OF NATURAL RESOURCES

VETERANS' MEMORIAL BUILDING, PROVIDENCE, R. I. 02903

DIVISIONS OF

Parks and Recreation
Conservation
Agriculture
Harbors and Rivers
Planning and Development
Enforcement

FREDERICK C. LEES
DIRECTOR

January 16, 1967

Remi O. Renier
Colonel, Corps of Engineers
Acting Division Engineer
Department of the Army
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Renier:

Ref: NEDED-R
Fall River Harbor, Massachusetts
and Tiverton Harbor, Rhode Island

Reference is made to your letter dated December 16, 1966 concerning your proposed report on Fall River Harbor navigation study made by your office and its scheduled submission to the Board of Engineers for Rivers and Harbors.

The recommended improvements, including deepening to 40 feet at mean low water the existing channel to Fall River and channels along the Tiverton shore of Rhode Island in the waters of Mount Hope Bay, and related work on existing bridges in Massachusetts, meet with this state's approval insofar as the Rhode Island portions of the project are concerned. It is noted that the total first cost of the project is estimated at $7,959,000 and that no cash participation in such cost will be required from Rhode Island.

As for the usual assurances of cooperation required of local interests in such projects, please be advised that while Rhode Island cannot make any legal commitment with respect to such assurances at this time, these requirements would undoubtedly be met for that part of the work located in Rhode Island, as they have been on similar projects before, when the project has received authorization from Congress and federal funds have been appropriated.

Sincerely yours,

Frederick C. Lees

Frederick C. Lees, Director
Department of Natural Resources

FCL:HI:mp

The Commonwealth of Massachusetts

Department of Public Works

Office of the Commissioner

100 Nashua Street, Boston 02114

February 13, 1967

FALL RIVER-SOMERSET
F-2-1=S-16-4

Colonel Remi O. Renier
Acting Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Renier:

Reference is made to your letter of December 16, 1966, concerning the Fall River Harbor navigation study, and recommending a project for deepening the harbor channel to a depth of 40 feet, and altering the Brightman Street Bridge to provide a wider draw span, contingent upon certain requirements of local cooperation, including removal by the Commonwealth of the Slades Ferry Bridge. Reference is also made to the Agreement between the Corps of Engineers and the Commonwealth, dated December 29, 1966, establishing the principles of cost apportionment, in accordance with the provisions of the Truman-Hobbs Act, that will be followed in determining shares of cost to be borne by the United States and the Commonwealth in the alteration or reconstruction of the Brightman Street Bridge.

Subsequent to the above, there was a meeting on this subject in Fall River on January 12, 1967, attended by representatives of the Corps of Engineers, the Massachusetts Department of Public Works, the City of Fall River, and the shipping interests concerned with Fall River Harbor. As a result of that meeting, it was agreed that the matter of the proposed widening of the drawspan through the Brightman Street Bridge would be reviewed, to determine if the opening should be 200 feet or 300 feet. The Department of Public Works was to determine the structural feasibility of the wider opening and estimate the added cost that would be involved.

The requested review has been made of the alternative proposals of a widening of the drawspan of the Brightman Street Bridge from its present width providing for a 100-foot wide clear channel to widths providing for either a 200-foot or a 300-foot clear channel. Either of these alternatives are structurally feasible. The estimated cost of the alteration to provide for a 200-foot channel is $2,300,000 and for a 300-foot channel is $3,600,000. It is noted that these are estimates, at current prices, and that actual costs would be determined at the time of project construction. It is also understood that the Commonwealth share of the cost of bridge alteration is estimated at $497,000, and that this share would be the same regardless of the width of opening adopted. It is finally noted, as stated in the above referenced Agreement, that the option of entire reconstruction of the Brightman Street Bridge would be a decision to be made by the Commonwealth of Massachusetts, but that the costs to be apportioned between the Corps of Engineers and the Commonwealth would be limited to those portions of the cost which would be in lieu of and equivalent to removal and reconstruction of that part of the existing bridge as necessary to provide for the channel widening.

The Corps of Engineers in its review has determined that adequate design would require a 300-foot opening, (and 135 foot vertical clearance if a vertical lift span is constructed), and the project recommendation is so revised.

The Department of Public Works cannot commit the Commonwealth of Massachusetts in respect to this project without an act of the Legislature. The Department concurs in the plan as a needed improvement to the port of Fall River. As a matter of precedent, it is believed that the Legislature has in the past taken the necessary actions to enable the State to undertake the necessary requirements of local cooperation on Federal navigation projects in Massachusetts.

Very truly yours,

Edward Ribbs

EDWARD J. RIBBS
Commissioner

21 FEB 1967

FALL RIVER HARBOR, MASSACHUSETTS AND RHODE ISLAND
INFORMATION REQUIRED BY SENATE RESOLUTION
148, 85th CONGRESS, ADOPTED 28 JANUARY 1958

1. NAVIGATION PROBLEMS: Fall River Harbor is one of the more important commercial harbors in New England. It is situated in two states, southeastern Massachusetts and eastern Rhode Island. It includes a channel to Tiverton, Rhode Island, as well as the channel to Fall River. Petroleum products, the chief industry handled, constitute about 57 percent of the annual commerce. Bituminous coal accounts for about 42 percent and the remainder consists of diversified products. The chief products are carried in bulk, requiring the use of tankers and colliers. The harbor has been deepened in successive increments to its present project depth of 35 feet below mean low water.

2. The chief navigational difficulty lies in the inadequacy of channel depths and restrictions imposed by limited channel width through two bridges. The channel depths limit navigation to ships of 32,000 deadweight tons size below the bridges. The further limitation on ship size stems from drawspan widths through the existing bridges. The lower bridge, Slades Ferry, has a horizontal clearance of 100 feet and the upper bridge, Brightman Street, a similar clearance of 98 feet. Numerous accidents have occurred in these spans in the past, resulting in severe damage to both the bridge structure and the vessels. Consequently, in the interests of safe navigation, vessels transiting the drawspans have been limited to 20,000 deadweight tons maximum. These vessels have a beam of 77 feet, which allows for 11.5 feet clearance on either side in the Slades Ferry Bridge drawspan and a similar clearance of 10.5 feet in the Brightman Street drawspan. Thus, it is apparent that even with these clearances, navigation through the bridges requires exercise of good judgment and seamanship.

3. As stated in the previous paragraph, navigation of the 35-foot channels below the bridges is possible for vessels of the 32,000 deadweight ton size. However, such navigation is limited to high tidal periods. This condition stems from the loaded draft of the vessels, which is 34 feet. Thus in the existing 35-foot channel the vessels cannot attempt passage of the channels until there is sufficient hull-clearance over the channel bottom for safe navigation. The accepted clearance is 5 feet and consists of such factors as squat or scend, uneven loading and sufficient clearance for rudder action. With the required 5 feet of clearance and a mean tidal range of 4.4 feet in the harbor, a vessel drawing 34 feet would require 39 feet of water, which occurs only in high tidal periods in the existing 35-foot channel. Future shipping will consist of larger than 32,000 deadweight ton vessels. Such shipping would be severely handicapped without channel improvement as the vessels could only be loaded to the safe draft of 34 feet, which would entail less than full loads, adding to the per ton delivery costs of the commerce.

4. IMPROVEMENTS CONSIDERED AND RECOMMENDED. Local interests requested deepening of both the Fall River and Tiverton channels to 40 or 45 feet; widening of both channels to 500 feet with further widening of the bend leading into the Tiverton upper channel and provision of a turning basin at the upper end of this channel; alteration of the drawspans of both bridges to provide wider horizontal clearances in the drawspans; or in lieu of bridge alteration, providing a turning and maneuvering basin below the bridges. The improvements were requested to allow for more general use of the larger tankers and colliers which are being used with increasing frequency in coastwise commerce. The use of the larger vessels would provide for more economical transportation of petroleum products and bituminous coal, and thus result in general benefits for the locality. Future commerce is expected to increase substantially. The increase will result from population growth, and the planned expansion of two conventional fossil fuel plants located in the harbor. Study of prospective commerce and shipping requirements in the locality revealed the need for improving both the Tiverton and Mt. Hope Bay channels throughout their entire lengths. It was found also local interests will remove the Slades Ferry Bridge. The remaining obstructive bridge at Brightman Street, will require alteration in the event of channel improvement to the upper harbor. Costs for such alteration have been apportioned according to provisions of the Truman-Hobbs Act. The recommended improvements consist of:

a. Deepening the existing 400-foot wide by 35-feet deep Mt. Hope Bay channel to 40 feet, within existing limits, from deep water in Mt. Hope Bay to and including the existing maneuvering basin.

b. Deepening to 40 feet the existing 400-foot by 35-feet deep Tiverton channel to the Tiverton waterfront, thence northerly to the vicinity of the Gulf Oil Terminal and widening the bend leading into the upper channel to 600 feet.

c. Providing a channel 40 feet wide and 40 feet deep along the waterfront in Tiverton Lower Pool to the vicinity of the Rhode Island Refining Corporation.

d. Altering the Brightman Street Bridge to provide for a clear channel width of 300 feet through the drawspan.

The recommended improvement would require removal of the Slades Ferry Bridge by the State of Massachusetts, and alteration of the Brightman Street Bridge drawspan also by the State of Massachusetts. Estimated first

2 1 FEB 1967

costs, annual charges, and annual benefits are based on November 1966 price levels; a 50-year project life, and a 3.125 percent interest rate on both Federal and local funds. Costs, benefits and comparisons are detailed as follows:

a. Estimated First Cost of Construction

Federal	Bay Channel	Tiverton Channel	Total
Channels	$ 3,710,000	$ 1,874,000	$ 5,584,000
Bridge Alteration	3,178,000	-	3,178,000
Total	$ 6,888,000	$ 1,874,000	$ 8,762,000
Non-Federal	497,000	-	497,000
Total (Fed. & Non-Fed.	$ 7,385,000	$ 1,874,000	$ 9,259,000

b. Estimated Annual Charges

Federal	Bay Channel	Tiverton Channel	Total
Interest & Amortization	$ 147,600	$ 74,600	$ 222,200
Additional Annual Maint.	19,400	4,400	23,800
Bridge Alteration	126,500	-	126,500
Total Federal Charges	$ 293,500	$ 79,000	$ 372,500
Non-Federal			
Bridge Alteration	19,700	-	19,700
Totals	$ 313,200	$ 79,000	$ 392,200

c. Estimated Annual Benefits

Annual benefits result from savings in transportation costs by allowing for the use of larger vessels, elimination of tidal delays for the smaller vessels and savings in annual towboat hire.

Bay Channel	$ 344,500
Tiverton Channel	95,000
Bridge Alteration	1,083,000
Total	$ 1,522,500

c. Benefit-Cost Ratios (50-Year life)

	Benefits	Costs	Ratio
Bay channel-deepening only	$ 344,500	$ 167,000	2.1
Tiverton channel	95,000	79,000	1.2
Bridge Alteration	1,083,000	146,200	7.4
Combined Project	$ 1,522,500	$ 392,200	3.9

5. APPORTIONMENT OF COSTS AND LOCAL COOPERATION. Benefits for deepening being general in nature, require no cash contribution by local interests. However, as bridge alteration comes under provisions of the Truman-Hobbs Act, local interests will be required to share in alteration costs of the Brightman Street Bridge proportionate to the ratio that expired bridge life costs bears to the original bridge costs. This amount has been estimated as $497,000. In addition, local interests would be required to:

a. Provide, without costs to the United States, all lands, easements and rights-of-way necessary for construction and subsequent maintenance of the project.

b. Hold and save the United States free from damages due to construction of the project.

c. Remove the Slades Ferry Bridge.

d. Provide and maintain, without cost to the United States, depths, commensurate with channel depth in berthing areas and local access channels, serving the terminals.

6. DISCUSSION. Local interests have been advised of the recommended improvement, and have provided reasonable assurances on the requirements of local cooperation. The recommended plan of improvement provides the most feasible and economical method of meeting the needs of future navigation. The project is considered justified on the basis of studies made for this report and criteria on similar navigation projects. Local cooperation requirements are in consonance with such requirements for similar navigation projects.